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Prize Winning Essays

The several winners of prizes and honorable mentions in the 1940 Duquesne University national science essay contest were announced late in February at the University's annual Conference for Teachers of Science. Members of the faculties of the University selected the prize winners.

To the winner of the first prize, a gold medal has been awarded; to her school, for one year's possession, a silver cup suitably inscribed. The prize essay will be published in the June issue of the *Science Counselor*.

In addition to the first honor, six honorable mentions, all of equal value, were announced by the committee of judges. These are listed below.

Miss Regina L. Kelly of Pittsburgh won the gold medal, signifying highest honor. Her essay, representing the **St. Rosalia High School, Pittsburgh,** was supervised by Sister M. Josephine, I.H.M., and Sister M. Macrina, I.H.M.

Honorable mention was given to the essays submitted by the following pupils and schools:

Kathleen E. Smyth, Bishop McDonnell Memorial High School, Brooklyn, N. Y. Supervisor, Sister M. Thomas Aquin, O.P.

Lawrence Flaherty, Central Catholic High School, Toledo, O. Supervisor, Sister Marie Therese.

Audry Lindinan, Lourdes Academy, Cleveland, O. Supervisor, Sister M. Dolores, H.H.M.

Mariagnes Verosky, Divine Providence Academy, Pittsburgh, Supervisor, Sister M. De la Salle, D.P.

Marjorie Hawe, Mt. Aloysius Academy, Cresson, Pa. Supervisor, Sister M. Assumpta, R.S.M.

Sara P. Gilson, John W. Hallahan Catholic Girls' High School, Philadelphia, Pa. Supervisor, Sister M. Catherine Francis, O.S.F.

More than a thousand students were represented directly and indirectly in the contest. Much good must have resulted from such spirited competition. It is interesting to note that Miss Verosky won an honorable mention in the 1939 contest. The Central Catholic High School of Toledo, O., also received honorable mention last year. The best record of all schools has been made by the Bishop McDonnell High School of Brooklyn. It won first prize in 1938, and honorable mention in 1937, 1939, and 1940.

"Nursing the Animal Kingdom"

• **By Sister Florence Marie Scott, S. C., Ph. D.,** *(Columbia University)*
DEPARTMENT OF BIOLOGY, SETON HILL COLLEGE, GREENSBURG, PENNA.

This is a human interest story.

All biologists, and many persons outside the field, know of the world-famous Marine Biological Laboratory at Woods Hole, Mass. Many biologists have been fortunate enough to study there. Many others would do so if they could.

Every Summer, hundreds of workers in biology, including the most learned as well as those not so far advanced, gather at Woods Hole to continue their studies and researches under almost ideal conditions. They come from every American university and from many foreign centers. Always included among them are a number of priests, brothers, and nuns.

Sister Florence Marie, who has studied there, describes the daily life of the workers during the season, the advantages to be gained from study in such a stimulating environment, and the special arrangements that have been made to accommodate Catholic workers.

●

A bare building, a row boat, two instructors, seven investigators and eight students started out together, in 1888, to become what is now the Marine Biological Laboratory at Woods Hole, Mass. In its heritage were two previous but more pretentious beginnings. The first, in 1873, by Louis Agassiz on the island of Penikese near the coast of Cape Cod, died, in 1874, shortly after the pioneer naturalist who founded it. The second, under the leadership of Alpheus Hyatt at Annisquam, had a life of six years and served as the immediate progenitor of the Woods Hole Laboratory.

Professor Whitman, the first director of the laboratory at Woods Hole, voiced his aspirations for the institution in his inaugural address,

> "Such a laboratory should be not merely a collecting station, nor a summer school, nor a scientific workshop, nor a congress of biologists, but all of these; an institution combining in itself the functions and features of the best biological institutes in the world, having the cooperation of the biologists of this country, and thus forming a national center of research in every field of biology."

The new undertaking, at its precarious launching, showed little promise of achieving the goal that Whitman envisioned for it. Today, it stands a dynamic monument to the courageous, unstinting, concerted efforts of those men, scientists and patrons of science, who buffeted successfully the many recurring blows that threatened the project with failure.

That same director of the laboratory, Doctor Whitman, once inquired of a young investigator what his friend, E. B. Wilson was doing. "Wilson," twinkled the soon to be famous Conklin, "Oh, he's nursing the animal kingdom." Only at Woods Hole could Wilson, of happy memory, have engaged in "nursing the animal kingdom." Probably no other research station offers the same opportunities for diversity in the selection of material. This is so largely because of the location of the station on a strip of land between Buzzards Bay on the one hand and Vineyard Sound on the other, where no rivers and no city sewage impair the purity of the sea water. Numerous basins and ponds supply fresh water flora and fauna to add to the wealth of marine life present in the necks, flats, "gutters," tide pools, and rocky stretches of shore and bays within easy reach of the laboratory.

For economy of research and time, the management of the laboratory provides a squad of trained collectors whose daily visits and spontaneous reflections make no small contribution to the genial atmosphere of the laboratory. This genteel method of securing material need not deprive the investigator of the joy of hunting his own specimens. A limited number of "passengers" may go out daily on the collecting boats that scout about the waters. The trip is apt to widen both the scope of interest and the original plan of the problem under investigation.

Another asset that extends the radius of possibilities for the selection of material is the presence of the Fisheries Bureau. Only a road separates the laboratories from the United States Bureau of Fisheries, and the finest spirit of cooperation exists between the two institutions. The Fisheries has a highly trained staff and corps of workers, and the superintendent is generous in permitting the laboratory people the use of records, materials, and boats when these are of service to the investigator.

Physical environment alone, though closely approaching the ideal, would not suffice to make Woods Hole so favorable a resort for scientific work. Without stimulating leadership, natural resources would little serve the advancing front of biology. The staff of the laboratory amply fulfills this role. Gathered together from every domestic university and a number of foreign centers, they might present, in another setting, a rather fearful board. In the delightful informality of Woods Hole they are a body of advisors, ever approachable, always friendly, always willing to share their rich stores of wisdom. Their enthusiasm is infectious, their generosity lavish. On the way to the Mess, walking along the Fisheries pier, watching the seals play to their responsive spectators, standing at the tennis match, loitering about the foyer of the "brick building," whenever you chance to meet them, they are ready to encourage, to suggest, to listen, to advise, or to "just

talk." The last is one of the most enjoyable diversions of the summer.

This body of living information is supplemented by a library in which is shelved every known periodical of import to biology and its allied sciences. The library is organized on the same basis of open friendliness. Any investigator has access to the stacks at any hour of the day or night. If he needs assistance, the librarian and her helpers are immediately at hand. The library, like all the laboratories, is open twenty-four hours a day.

When a piece of research reaches completion, there is an opportunity of presenting it either in the evening seminars or in the symposium at the end of the season. At these times there is open discussion and sometimes animated debate! But, in any case, there is exchange of opinion, and that always helps to keep the investigator investigating.

For students not yet prepared to undertake independent research, there are courses fitted in their content to the natural resources of the location. The courses are manned by a faculty of specialists, any one of whom can suggest fields for exciting investigation and open fire on a battery of questions still unsolved. Obviously these courses serve as germinating beds for research workers not only at Woods Hole but far and wide around the compass.

Social life is not lacking. There is no organized social activity that would be the bane of the conscientious scientist. Woods Hole is in no sense a "summer resort" with all the disquieting innovations implied by the term. There is a beach, perhaps a trifle rocky, where the water is known to be more temperate than at any other point along the Cape. Everybody takes time out either for a short exhilarating swim, or for a longer swim and discussion on the sunny sands. Many a knotty problem has been untangled on those sands from which the footprints of the "Makers of Biology" have been transferred to a more lasting medium. For the more athletic, there are tennis courts and tournaments to go with them. But for all there is the integration of friendly intercourse and advice with the day's work. An atmosphere of informal friendliness pervades all the laboratories and everybody comes to know everybody else fairly well (biologists being notoriously friendly) and this is apt to result in a liberal education by the end of one season.

Carrying on casual conversations is an easy way of keeping apace with the rapid development of a fast moving science. Listening to the "graybeards" in an evening's lecture is an excellent way of achieving firsthand acquaintance with personalities with whom we have been otherwise familiar through our days as a student and instructor. It imparts a feeling of contact that enlivens our teaching and fires us to participate actively in the field of research. The common dining room, the "Mess", provides another opportunity for the pooling of opinions. Evening lectures carry over to the breakfast table.

The town of Woods Hole is a typical Cape Cod community whose residents are associated with the Fisheries, fishing, the laboratory, the Coast Guard, and the functional activities of any small hamlet. It *is* a small hamlet, but a distinctive small hamlet! It opens its hospitable arms to the influx of five hundred summer residents and cares kindly for the "bug hunters", as it calls them, who all summer interfere with the orderly serenity of the lives of the "natives" and then abandon them to the quiet of winter. They contribute to the spiritual comfort of those who wish such comfort in an easy, graceful fashion. Catholics, particularly, are benefited by the presence of a well established church and resident pastor who arranges Sunday Masses with the convenience of the scientists in mind. Daily Mass and evening services are provided with prompt regularity, and the pleasant little church is always open for private devotions.

Directly across the road from the church is the granite Angelus Tower which Mrs. F. R. Lillie planned and presented. It houses not only the bells for the Angelus but also a small library of interesting books of religious nature. Surrounding it, and dedicated to the Mother of God, is a quaint garden dropping abruptly over the stone breakwater into the waters of Eel Pond. Eel Pond is a circular inlet, a third of a mile or so across, which really designs the town, for all the dwellings and buildings rim it.

Mrs. Lillie is responsible, too, for the establishment of Mendel House where eight or nine of the clergy may reside during their seasons of concentrated research. The house is furnished with a private chapel for their convenience. Despite the fact that similar accommodations are not available for Sisters, satisfactory arrangements are easily made and happily executed.

The opportunities of the laboratory are closed to none. The group is cosmopolitan. All are received and evaluated on their own merits as objectively as human nature permits. There are facilities available for all to use whether their powers be large or small in scope. There is no discrimination. Everyone is received with open mind. He makes his own impression, which is to say that the reaction to him is reduced to the personal equation, and that, no doubt, is the situation in almost any group of fair-minded intelligent people.

Woods Hole is the Mecca of biologists. No other group of scientists, in fact, no other group of any kind of specialists enjoys the opportunity of being together under such unique circumstances. Last year the psychology department of Cornell University made an initial attempt to duplicate the ideal circumstances for psychologists on the Cornell campus, setting forth that they wanted for the psychologists "the closest approximation to what Woods Hole provides for biologists". It will be interesting to watch the result, merely because it is difficult for a biologist to project any other such venture on his mental horizon. Only if of itself such a venture can generate the spirit of Woods Hole, would he wish for its success.

E. B. Wilson, at the end of a greeting to Frank R. Lillie on the latter's sixtieth birthday, which was celebrated at the laboratory in the summer of 1930, expressed the spirit of cooperation and binding friendship that dominates the laboratory:

Continued on Page Twenty-Six

Can the Student be Made to Want to Learn Science?

• **By Oscar L. Brauer, Ph. D.,** *(University of California)*
DEPARTMENT OF NATURAL SCIENCE, SAN JOSE STATE COLLEGE, SAN JOSE, CALIFORNIA

Teachers are properly concerned about adjusting the content of their science courses to the needs of their pupils. Read here how one enthusiastic and practical instructor in a western high school was able to interest his class in some of the problems of the people of their own community.

Dr. Brauer challenges your thought. We believe that you will agree with him in most of his conclusions.

Can you improve on his definition: "Science education is the process of opening our eyes so we can see what God hath wrought"?

This is another "must" article.

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There is an old saying which goes: "You can lead a horse to water but you cannot make him drink." This seems to be also true with respect to students when led to the academic trough. Only a limited number quaff deeply of its contents. Far too many either neglect to drink or simply take a sip now and then, hoping thereby to pass the course which seems to be an obstruction to the even tenor of their ways.

On the other hand when a student wants to learn we cannot but marvel at what he can accomplish. Take, for instance, the radio amateur. I have seen boys, who without ever having studied science of any kind, have been able to dig out of the voluminous articles on radio the fundamental conceptions of electricity, the laws, and even some of the intricacies of high frequency current. Surprising as it seems, they talk quite intelligently about such involved subjects as impedance and push pull amplification.

We must sell our science subjects to the students. Not only must we convince them that science is interesting and worth while in general, but we must convince them that it is worth while to them individually and that its knowledge will directly and materially benefit them individually.

How can we interest the student? There are many ways, no doubt. The following are a few suggestions:

Spectacular Experiments and Demonstrations

The spectacular is always interesting. One cannot help but be attracted to a spectacular demonstration, whether it is done by a fakir at the carnival or by a demonstrator at the fair. Old and young will gather around to watch. When we have aroused the curiosity, we have gone a long way towards arousing a desire to learn. The sciences, above all other subjects, offer opportunities for the spectacular.

The skill of the teacher comes in introducing the problem. The "what makes it work"? type of problem frames its own question. Even more valuable, however, is the problem which nature is asked to answer by the experiment. If the student knows the question and is asking in his mind what answer will nature reveal through the experiment, he is in the right frame of mind for learning. This is where the fill-in type of notebook has its advantage. Too much time consumed in writing up the experiment is tiresome to the student and damping to his enthusiasm.

Science Is of Immediate Practical Value

It is the inability to see the immediate practical value of science that sometimes makes it hard for such subjects to compete with typing and automechanics. In chemistry, practical problems are all about us.

While I was teaching high school in a western town, back in the days of war prices, the principal came to me one day and said: "Can you find some way to compare liquid soaps? Here are three samples of soap, costing 36c, 55c, and 75c per gallon. Which is the best buy? I have no basis on which to judge them."

The method had to be something quite easy to carry out since the high school was not equipped for quantitative analysis which requires expensive balances. Reasoning that the essential difference between two liquid soaps is the relative quantities of soap and water, I thought that one might get a rough comparison by adding mineral acid and comparing the volumes of the fatty acids liberated. By measuring equal volumes of the three soaps into three test tubes and adding a small volume of dilute sulfuric acid to each sample, the fatty acids melted with the heat of reaction and separated as an oil at the top. Since the tubes were of equal cross section, the depth of the oil was taken as the measure of the soap. Very crude, it is true, yet probably accurate enough for a rough comparison. Letting the students in on what we were doing and why, created considerable interest and showed them one way chemistry could be of practical value.

Another time a laundryman wanted to compare two samples of soap quoted at quite different prices. On the assumption that the largest factor determining the difference of price was the moisture content, weighed samples were carefully dried. Not only did this determination help the laundryman, but it showed the students another case of how chemistry can be of practical value.

This high school was in a fruit raising district and the students were allowed to measure the sugar con-

tent of grapes and oranges by the hydrometer method. Since grapes and oranges were kept or rejected at the packing house on the basis of these same tests, our work seemed very practical.

One spot near this high school was covered with black alkali, so much that plants could not grow. Black alkali is essentially sodium carbonate which has dissolved enough of the soil humus to make the surface black. Sodium carbonate is caustic enough to kill most plants. After a study of alkali soils in class, we came to the conclusion that if the sodium carbonate were changed to the non-caustic sodium sulfate, plants might still grow on that soil. As a project we sprinkled the ground with dilute sulfuric acid. The farmer planted corn and later there was a good crop. These students wanted to learn about alkali, and the reaction of sulfuric acid on carbonates became practical chemistry.

Science teaching in the past has sacrificed the practical for the theoretical. Laws and theories have their place. However, to the student the practical far outweighs the theoretical, and sticks in his memory better. If we teachers look back on our own experiences I dare say that some trip to a factory, or industrial plant, or laboratory stands out more clearly in our memories than the routine of class work. It was the practical, objective side of the industrial plant that made the lasting impression.

Selling the Subject to the Student

At every step of the way we need to show the student what science is doing to advance our civilization, how it has given us more leisure time, how it improves on the products of nature, how it creates new products more suitable for certain uses than anything previously available, and how it aids in consuming what nature has so generously given us.

It is easy to show that the knowledge of science will make a more successful farmer, a more successful teacher, a more successful banker, a more successful housewife. The knowledge of science is bound to return practical benefits to every individual in every walk of life. It opens vistas of enjoyable reading which to the uneducated would be meaningless. Science opens avenues of interest in every direction. The fields are no longer just grass, bushes, hills. The mountains are not just rocks and trees. To the botanist, the cow pasture has scores of items of interest. To the mineralogist, every step over the mountains may reveal new interest. The chemist sees oxidation, decay, and cellulose materials. He observes charred snags protected from decay by charcoal. He notes with interest the sulfur or soda springs. He, too, studies the minerals.

The desert, to the uneducated, is a vast expanse of worthless waste land. To the scientifically educated, it is a vast storehouse of mineral wealth. It is an open laboratory where hundreds of the processes of nature operate without restriction. Science education is the process of opening our eyes so we can see what God hath wrought. If the student can be made to see all this, surely he will want to know some of it.

Do We Stifle Interest by Attempting Too Much?

Time was when only the academically-minded youth went through high school and to college. By academically-minded we mean those who are either driven by an irresistible craving for knowledge or who have an unusual capacity for absorbing information. Skilful teaching was unnecessary. The lecturer simply had to pour it out for the students to absorb.

Today, the situation is far different. Partly because there are no jobs waiting for non-academic youth, and partly because of legal enactment, practically every boy and girl must go to high school whether he has the capacity to absorb knowledge at the customary rate or not.

The pace was set and the subject limits were established when the students were a select group. Today, in spite of the fact that the average student has less learning capacity than formerly, we attempt even more than was attempted then. During the last three decades science has unfolded with an ever accelerating speed. Secondary teachers have been eager to embrace it all and crowd it into courses already heavily loaded. The alarming question is where will it end? Can we improve our teaching techniques so that our students can absorb it all? This is not probable. Wouldn't it be better for us to decide what is a reasonable goal, and then say this much we will attempt and no more.

In chemistry, atomic structure has opened up a new field, a field as yet based largely on higher mathematics. Shall we try to present its bones without the mathematical meat? Or had we better leave that to the colleges and universities? Wouldn't it be better to allow the college teachers something new to present, rather than compel them to rehash and enlarge that which we have already attempted, in many cases only superficially.

Elementary Science to the Rescue

One factor in the science situation that is now rapidly developing may help relieve the congestion in subject matter. This is the organization of science teaching in the elementary grades. If the elementary teachers succeed in developing the natural curiosity of the child, and create an intelligent liking of science before it has to compete with the stresses of adolescence, this liking may carry over and make the task of the secondary teacher much easier. The secondary teacher then can be less a salesman and more a teacher. Until that time, however, the secondary teacher must function as both salesman and teacher. If he fails as salesman, he is doomed to fail as teacher.

Being Salesman Is Good for the Teacher

Being a salesman of his subject has a tonic effect on the teacher. It keeps him from becoming too far out of contact with practical life. The successful salesman is necessarily an enthusiast. His enthusiasm must be catching if he is to succeed. Contagious enthusiasm is one of the best characteristics of a good teacher. It may be best that the grade teacher never entirely take over the task of selling the subject.

Continued on Page Twenty-Three

Does High School Chemistry Function in College?

• By Harold A. Iddles, Ph. D., *(Columbia University)*
PROFESSOR OF CHEMISTRY, UNIVERSITY OF NEW HAMPSHIRE, DURHAM, N. H.

Does secondary school training in chemistry contribute to the success of the student who later studies chemistry in college? This is another way of saying: Are high school teachers of chemistry doing a good job? Do you care to know?

Should college students who have had previous training be segregated? Is there a better method of sectioning? Of what value are placement tests for Freshmen in predicting future success? Is there a close correlation between the ratings made at entrance and those received during the course and at its completion?

Teachers of college chemistry as well as those in the high school field will be interested in the results of this study. This article is an abstract of a paper presented by Dr. Iddles before the Summer Conference of the New England Association of Chemistry Teachers at the University of Vermont, in August, 1939.

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In discussing the subject, "Does High School Chemistry Function in College?", I wish to relate the impressions which the Department of Chemistry at New Hampshire has gathered in dealing with a varied group of college students, some four hundred in number each year. Their interests range from that of the Liberal Arts student taking a science elective to that of the professional student of Engineering, Agriculture or Home Economics, or pre-professional student of Medicine or Dentistry.

I. Contributions of secondary school chemistry course.

A. It is a striking fact that the secondary school chemistry course arouses the original interest and enthusiasm for chemistry on the part of those who study chemistry in college as a major, and undoubtedly serves an even larger function in offering a glimpse of chemistry as it affects our everyday life to those who proceed no further. For instance, among the special group who decided to major in chemistry or chemical engineering with us this past year, every student but one had had high school chemistry. Most of these men had made their decision before reaching college although a few made the choice after experiencing a semester's further work in college.

B. In working with those who have had high school chemistry, one finds that they have retained much factual and descriptive material, probably an amount which might be expected from a first perusal of the subject.

If such a broad outline is followed, as suggested by Hopkins, Mattern, Segerblom and Gordon*, then certainly the college may expect some acquaintanceship with such topics or units as the chemistry of water and the part it plays in many chemical phenomena; elements, compounds, mixtures and chemical change; the structure of matter; symbols, equations, weight and volume relations; acids, bases, salts, solutions and ionization; the preparation and properties of certain nonmetallic elements such as oxygen, hydrogen, nitrogen, sulfur and chlorine; the same for a few representative metals such as sodium, calcium, iron and aluminum; perhaps something about carbon and the oxides of carbon.

C. There seems to be some familiarity with experimental work, although a great variation exists which reflects a wide difference in the physical possibilities offered by different schools.

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II. What plan may the college adopt which will utilize the student's previous training in chemistry to the greatest advantage?

A. For some years it was our practice to section the entire class in general chemistry into two groups, those with and those without previous chemical training.

With the first group, the instructor proceeded to redevelop the subject, assuming a certain background and familiarity with chemical terms. This review can be accomplished in an interesting manner by a skillful instructor and at the same time give the student much supplementary material, since a college text is designed to offer a more complete and mature treatment of the subject and often is presented in a different order than previously. According to the interests and travel experiences of the instructor it is desirable to introduce some historical material which serves to make certain scenes, events and well-known names stand out as real in the student's mind.

Much of the subject matter was covered by means of lectures and the descriptive type of experiment was reviewed as lecture demonstrations. This allowed a fresh approach to be developed in the student's own laboratory work, particularly from the standpoint of reasoning and making deductions from the observed experimental facts. As many have noted, this group will have better grades than the second group which undoubtedly may

*Hopkins, Mattern, Segerblom and Gordon, *J. Chem. Ed.*, *13*, 175 (1936).

be attributed to their natural aptitude for science which prompted them to elect the subject in secondary school.

With the second group, no previous training was assumed so that the subject was developed more slowly from the beginning. By omitting some details and covering the bare essentials, it was possible to complete a reasonably complete college text in one year. A few students did very well, but often the grades were lower than was the case with the first group. This might be expected since the academic interests of this group are often in other fields than science which is in line with the fact that an earlier course in chemistry was omitted.

B. The above basis of sectioning however proved to be too arbitrary, for we found that many of the first group could profitably have been in the second or beginning group, but rarely the reverse. In other words, such a basis of division assumes a uniformity of product from the secondary school which would be ideal but impossible to realize in any educational situation.

Consequently for the past few years, our sectioning has been based on the results of placement tests in both aptitude and training given during Freshman week. As an example, at the beginning of the academic year 1938-39, one hundred twenty-one Freshmen who were prospective engineering, chemistry, or chemical engineering majors, were given the Iowa Placement Examinations, New Series, C. A. Form Y and New Series, C. T. Form Y. The results of the tests were tabulated on a scale up to one hundred and a group somewhat arbitrarily chosen who were above 50 in both parts. This gave a group of forty-six students who were placed in a special section. A recent extensive college text was chosen (Briscoe's—*General Chemistry for Colleges*), the same type of lectures and review demonstrations were given, and the same approach to the laboratory work was employed as previously described. In this section there was a lively participation in oral discussion for the students possessed enough background to talk and seek correlations and explanations of their previous experiences in chemistry with the topics under discussion at the moment.

At the end of the first semester, the group who desired to major in chemistry was determined but the whole section remained intact, even though it was made up of students with a variety of professional objectives. A few additional men from the second group, who wished to major in chemistry but had not qualified earlier, were admitted to the special section.

At the end of the college year, the twenty-four chemistry majors took the Cooperative Chemistry Test for College Students—1939 (prepared jointly by the Cooperative Test Service and the A. C. S. through its division of Chemical Education). In the accompanying table is listed a group of fifty-four students according to descending order of aptitude rating. In the second column are their training scores; in the third and fourth columns their college grades are given, and in the last column the percentile ratings on the cooperative test are given.

TABLE I

No.	Percentile for Group Taking Examination		College Grades		Cooperative Test Reporting of 157 Colleges Covering 8705 Cases. Percentile
	Aptitude	Training	1st sem.	2nd sem.	
1	100	92	92	96	99
2	99	97	90	94	98
3	98	23	68	60	
4	98	95	90	85	90
5	98	100	90	(dropped)	
6	96	99	90	94	
7	95	73	84	88	
8	95	71	87	78	
9	95	91	88	90	97
10	95	76	85	90	
11	92	59	75	80	80
12	92	94	90	83	88
13	92	73	72	60	
14	89	..	80	65	50
15	88	57	89	86	86
16	88	80	76	70	
17	86	98	92	92	91
18	86	88	80	68	
19	86	53	75	78	
20	86	81	82	82	88
21	83	52	78	75	
22	83	65	82	84	
23	81	75	87	90	88
24	81	50	70	60	
25	81	77	82	88	
26	79	55	85	80	
27	79	79	88	90	
28	77	84	76	84	
29	77	78	74	60	
30	77	93	87	74	86
31	77	69	74	84	
32	77	60	65	60	
33	72	75	75	80	
34	72	44	82	76	70
35	69	50	70	72	
36	69	84	75	72	
37	69	59	88	80	80
38	69	86	65	60	
39	66	87	78	82	
*40	66	42	80	80	84
41	66	65	70	62	
42	66	92	84	85	
*43	61	44	80	84	70
44	58	89	90	86	94
45	55	56	75	78	
46	52	84	70	(dropped)	
47	52	81	72	65	
48	52	60	82	78	70
*49	52	36	74	82	65
*50	46	31	73	75	70
*51	44	97	82	82	90
*52	35	15	75	82	90
*53	18	35	75	68	55
*54	14	57	75	74	60

Viewing the table as a whole, it is evident that a close correlation exists between the ratings made at entrance to college, during college and on a national examination at the end of the college year. Some explanation of individual cases is of special interest when the personal factor of acquaintanceship can enter into the interpretation of the ratings. Cases 1 and 2 are consistently outstanding in scholastic work, personally and in all college activities. Case 3 was admitted on the basis of a very high aptitude, even though falling below par in training, but in both chemistry and mathematics he lacked sufficient application to come up to his aptitude prediction. Case 6 is not a chemistry major but shows that there can be sufficient interest for the general student to profit from such a system of sectioning and that he can attain a high standard of excellence. Case 37 is an example in which the student in his later work has risen to a higher level than was first indicated. Case 38 had two years of preparatory chemistry and thus had a high training score, but later work confirmed the accuracy of the aptitude figure. All of those marked with an asterisk were not included

Continued on Page Twenty-Eight

Science Experiences with Ten-Cent Store Equipment

• **By Carleton John Lynde, Ph. D.,** *(University of Chicago)*
TEACHERS COLLEGE, COLUMBIA UNIVERSITY, NEW YORK CITY

Teachers of science are familiar with Professor Lynde's first book of experiments to be performed with home equipment. His second book, recently published, is reviewed elsewhere in this issue. The third, from which these "experiences" have been selected by the author, will soon be ready.

Dr. Lynde is doing a valuable work in showing teachers how easy it is to teach the fundamentals of physical science without elaborate and expensive apparatus. Through the use of materials familiar to the pupils, he shows them that science is not restricted to the laboratory but touches their home life at many points.

Our readers will be interested to know that Dr. Lynde, Professor Emeritus of Physics at Teachers College, was selected to deliver the three Christmas week lectures for young people at the Franklin Institute in Philadelphia, December 27-29, 1939. These lectures are sponsored by the James Mapes Dodge Foundation.

●

You Find a Gold Mine

Go to a ten-cent store and buy two mirrors about 8" x 6" for ten cents each. Place them facing each other as shown, and put a gold ring on the lower mirror. You will see many gold rings, by multiple reflection. Note the drawing on the opposite page.

A Spectrum from a Mirror in Water

Place a basin in strong sunlight, fill it with water, and put one of the ten-cent store mirrors under water in a slanting position. You will see a beautiful spectrum on the wall, because the sunlight goes through a triangular prism of water when it passes through water to the mirror and back.

You See a Big White Ghost

Look steadily at the white nose of this black figure for one full minute. Then look steadily at one spot on a distant white wall. You will see a white ghost, and the farther the wall the bigger the ghost.

The cause of this is retinal fatigue. Your retinae become fatigued by the white in and around the black figure, but rested by the black. You then see white where the figure is black, and grey where the figure and surroundings are white. As a result, you see a white ghost on a gray background.

You Triple Your Money

Put a quarter in a tumbler *half* full of water, cover the tumbler with a saucer, hold them together and invert them. You will then appear to see a quarter and a half dollar. You see the quarter through the flat top of the water. You see the half dollar through the curved sides of the water, which act as a lens and magnify the quarter to the size of a half dollar.

A Fish in Water Is Never Where It Appears to Lie

Fill a saucepan *to the very top* with water. Let a coin represent the fish, and drop it into the water *at the far side* of the saucepan. Now keep looking at the coin while you walk backward away from the saucepan, and the coin will appear to rise; so will the bottom of the pan. Walk toward the saucepan and they will appear to sink.

The cause of this is refraction. The light from the coin to your eye is refracted or *bent toward you* at the point where it passes from water into air. This refraction makes the coin appear to be higher than it really is.

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These science experiences are from my new book, *Science Experiences with Ten-Cent Store Equipment*, which is being published by International Textbook Company, Scranton, Pennsylvania, and which will appear in April.

This book is the third of a series. The others are: *Science Experiences with Home Equipment*, and *Science Experiences with Inexpensive Equipment*, both published by the International Textbook Company.

The idea underlying these books is:

The *time* to interest a child in science is when he is about ten years old, and the *way* to interest him is to give him a chance to experiment by himself in his own home.

When my son was ten years old, we happened to give him a $3.00 Chemistry Set at Christmas time. I was simply astounded at the result. In no time at all, it seemed to me, each of the six boys in his gang had a chemistry laboratory in his own home. The interest was intense, it kept up for years, and it spread over into electricity, engineering, and the like. That was twenty-five years ago, and out of that gang of six boys two are now Ph.D.'s in chemistry, one is a Ph.D. in physics, two are electrical engineers, and the sixth is a newspaper editor.

I do not claim that the chemistry set produced this result by itself, but I do believe it helped.

I believe, also, that the time to interest a child in science is when he is young, and the way to interest him is to give him a chance to experiment by himself in his own home.

Continued on Page Twenty-Six

mirrors
gold
You find a gold mine
You see a big white ghost
strong sunlight
Red
Violet
spectrum on the wall
mirror
pan full of water
The spectrum from a mirror in water
You triple your money
water
coin
A fish is never where it appears to be

Biological Drawing and Logical Thinking

• By John Paul Givler
HEAD, DEPARTMENT OF BIOLOGY, THE WOMAN'S COLLEGE OF THE UNIVERSITY OF NORTH CAROLINA, GREENSBORO, NORTH CAROLINA

Teachers of biology are prone to discuss the perennial question of "drawings" without coming to a satisfactory conclusion. Here is a teacher who has thought the problem through. He considers first the results that are to be desired, and then how these may be achieved.

Those who use them will be interested in his opinion of the value of prepared outline diagrams. Teachers will want to know why he considers that the drawing of an object in the biological laboratory embodies the record of an exercise in logic.

Professor Givler adds to the interest and value of his paper by giving definite and detailed directions for teaching students how to draw the crayfish.

●

"The head must plan with care and thought before the hand can execute."—*Schiller*

"The superior man bends his attention to what is radical (fundamental). That being established, all practical courses naturally grow up."—*Confucius*

●

For several decades, as every teacher of biology knows, drawing has been the principal method by which the elementary student records his observations in the laboratory. Following the example of Thomas Henry Huxley, who fathered the general biology course with his work as an educator in Victorian England, the college student was taught to observe and then make drawings in order to record his findings—mainly morphological—in the study of living things. In the hands of good students the method had, and still has, much to recommend it, for it stimulates and challenges observational powers.

But when biology spread from its humble beginnings to become a worldwide staple of educational discipline; when it left the circle of the favored few to join the curricular pabulum of practically every university, college, and high school in the world, new problems were introduced. So great was the initial impetus of this valuable, intriguing, and "humane" type of scientific training that it was many years before anybody seemed to realize fully that the inherent values of biology as a study had been profoundly altered by the world-conquest which it had achieved. A teaching subject becomes a somewhat different thing when it is transferred from one country or cultural setting to another.

Leaders in biological education have come forth with two conclusions as far as drawing is concerned. Their first recommendation was to discard it, in large part, on the ground that it had little educational value. As was obvious, the inept students were only tortured by being required to do something beyond their powers. Equally obvious was the fact that the few who, by nature, were good draughtsmen made a mere drawing lesson out of their work in the laboratory, understanding thoroughly very little of what they pictured. For these reasons many teachers, courses, and guides turned to the method of written description, question answering, or work with charts and models.

A second type of reaction against drawing by students has, of recent years, developed to very considerable proportions. It involves the method of supplying the student with a notebook, looseleaf or otherwise, presenting a series of printed outline diagrams or of finished drawings. The plan is for the student to complete the outline and then compare it with the specimen, affixing labels, as also with the alternative course, that of supplying the student with finished diagrams. In either case, it is clearly to be observed, there is the patent confession that we should return to pictures of some kind, for the picture tells more than the written or printed word. But as the students cannot draw, or because they do not draw fast enough to cover all the ground we want to cover, we should supply them with ready-made diagrams or do nearly all the work for them with the printing press. We may well pause at this juncture in order to look about us and enquire just where we stand, what we are attempting to do, and whether we have not failed to analyze properly some of the main factors here involved.

To me, the fundamental question is this—is our job to turn off so much teaching as our share in getting many students through the educational mill, or are we endeavoring to vitalize and humanize our subject in the interest of the student's deeper understanding of values and relationships? It is easy to "teach", but a real educator must work both hard and intelligently at his task and be somewhat of a genius to boot. Moreover, as many young teachers fail to realize, to teach biology effectively one must not only know something about a great many other subjects, but one must also develop insight into the relations of things. For this the teaching of biology seems to offer rare and unusual opportunity.

Historically speaking, biology arose in ancient Greece in an atmosphere redolent with a sort of spiritual perception of the meanings of the universe and as a part of the activities of broadly interested and deeply learned men. Later, in Renaissance times in Europe, biology had its rebirth in an environment distinctly artistic in spirit and temper. It was, in fact, the artist who then rescued biology from decadence. Quite contrary to what

a student trained in a modern university might imagine, biology did not arise out of the joint activities of a group of narrow and intense specialists but, rather, out of a broad and philosophical view of the setting of life in relation to nature.

Another factor in the problem we face is that biological education involves not merely the logic of the facts revealed through observation and experiment, but also the psychology of the student. It was the relationship existing between the obverse and reverse sides of this situation that formed the burden of the philosophical studies of Immanuel Kant. In simple language the problem finds its solution in the discovery of practicable *methods*, a theme so important that some scholars have declared—"the method is everything."

The object of teaching biology, as in teaching anything else, is to produce a *change* in the student's mind. It is hard to change minds, harder than to shape steel or to grind gems. Any change in minds, to be worth while, should be a considerable change. This demands *gradualness*. The student must be inducted into a method by which he learns to take one step after another on a ladder which leads to the attainment of new horizons. His young mind must not be spoiled by blundering, indecision, or false moves. He should be led to find the path by which he is to ascend. To do this he must be shown, first, how to survey broadly and, then, how to analyze a problem. Fundamental things demand first attention, after which those of lesser importance fall into a natural category in succession—seriatim. In time the student will see the value of this procedure and will make it habitual. Through the study of biology by methods involving drawing the present writer is also convinced that habits of work may be formed which will prove effective and serviceable in many other human endeavors.

This desirable educational result cannot accrue from lessons in which the student is furnished with a finished figure ready to label. Obviously, in this, there is no *method* involved. There are no steps to Parnassus. Student and teacher together are deceived into thinking that a labor-saving device has accomplished a miracle. To be sure education is an inexplicable "miracle", but it is one accomplished only through "brain-sweat" plus intelligent guidance.

Several years ago, while teaching in a summer session, I experienced a realization of values involving logical method inherent in drawing. Like most other teachers, up until that time, I had been in the habit of allowing my students to find their own way, for the most part, and to do their drawing of a natural object according to the method they discovered to be most convenient. Although realizing that it may not be well to interfere with originality, I came to see that most of such student effort results in helpless floundering and futility. I also found that sound method releases student initiative and originality rather than hampering it.

Students attending an art school are taught to draw—if possible, but if one studies biology in a university it seems to be assumed that one will "pick up" a knowledge of the art of drawing. Many biologists draw very well but they seldom analyze their methods and, perhaps, also hesitate to impose their own method upon their students. Yet, in biological drawing, method is more important than a presentable picture; just as, in mathematics, method outweighs in value the obtaining of the correct answer to a problem.

In the view of the present writer drawing, in biology, is of greatest utility in method concerned with the perception and ranking of what we may call a *hierarchy of values*. The several components of a given complex are far from being of equal importance. Of these, there is always some one factor which stands out head and shoulders above its brethren. The discernment of such factors both requires and develops insight, and insight is priceless while mere eyesight is commonplace. In most morphological situations the discovery of the plan of symmetry is the first and most fundamental issue and must be provided for in any drawing of an animal or plant before any other factor in the situation can receive attention. Then, in order, one at a time, come the things which follow in basic value or significance, and so on to the trivial details.

In this way the drawing of an object in the biological laboratory embodies the record of an exercise in logic. The student becomes a sifter of values, always looking first for the really big principle. In so doing he receives early discipline which might later be turned to good account in diagnosis, law or architecture. Without emphasis upon this logical factor the student is missing one of the main values of biological study. On this very principle hangs the gist of that most often quoted story about Louis Agassiz at Harvard—how he cryptically reiterated his demand that the student "keep the fish wet" until he finally discovered what he should have seen first of all—that the fish was an embodiment of the plan of bilateral symmetry.

As teachers of the sciences we must not be deluded by the groundless faith that scientific education has peculiar or inescapable values for our students regardless of the way in which courses are conducted. Most of all, the biological laboratory fails of its high mission if it degenerates into a place of aimless "busy work". Any study worthy of a place in the curriculum must have a definite intellectual content, by which I mean that it must both challenge and train logical powers of analysis and reasoning or otherwise develop thinking ability.

Let us illustrate the principles just outlined by the study of a familiar organism, the crayfish. This is a complex animal which might well terrorize an elementary student were he asked to make a drawing of it. The first rule is that no line should be drawn until the animal has been studied for at least half an hour. One should then plan the first drawing from the dorsal aspect for reasons soon to become apparent. From this viewpoint the discovery may soon be made by any reasoning student that the pattern of formed parts is one of two-sided symmetry, disposed to right and left of the most important line in the drawing—a line, by the way, inscribed by intellect and not by nature.

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Why Form a Science Club?

• By Sister M. Aida Ryan, O. S. F., M. S., *(Marquette University)*
MADONNA HIGH SCHOOL, AURORA, ILLINOIS

Some teachers excuse the absence of a Science Club in their schools by saying that they are too much trouble, they require too great effort on the part of teacher and pupils for the results that are obtained, and that clubs fail to function unless teachers drive. They point out that it is hard to find a suitable time for meetings. They foresee difficulties in enforcing eligibility rules sharply.

Sister Aida believes that clubs are worth all the trouble they bring. If the proper machinery is set up, they will function smoothly. She points out the desirability of having the local club affiliate with a state or national organization.

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The term "club," as it is used here, means an association of persons who meet for a common object, the members of which are limited in number and chosen by ballot or by a similar method. The common object might be the pursuit of biology, chemistry, physics, astronomy, or any particular phase of these sciences. Thus biology students, for example, interested in making a particular study of birds, might form an Audubon Club.

A club, from the standpoint of the teacher or sponsor, is a tool with which he can accomplish work in school more efficiently than he could otherwise. The club affords an opportunity for the teacher to shift some responsibility to the students.

From the standpoint of the student, the club provides for a worthy use of leisure and a means of advancing in a chosen line of activity. Those who belong to the club have the opportunity to form worthwhile friendships with boys or girls whose tastes are similar to their own. The club will develop initiative, create and intensify interests in things worth while, and give the student a momentum of interest that will carry him over the vacation.

Boys and girls of high school age have an innate tendency to initiate some form of organization. They will "gang" together whether we want them to or not. The school club provides an outlet for their social urge and a means whereby their activities can be carried out under the supervision of the teacher.

Approbation, particularly that of his companions, is the delight of every high school student, and the election to an office by his companions has more than once been the making of a boy or girl.

The *aim* of the club is the first and most fundamental objective to be considered. Unless there exists in the mind of the initiator of the club a definite need for work to be done, the organization of a club should not be undertaken. Clubs which are organized simply to occupy space in the school annual can scarcely be credited with a worthy aim. A Science Club should naturally have a scientific aim, such as: to increase knowledge and promote interest in science among the members of the organization by their reading of scientific literature, discussing scientific subjects, following up scientific programs and the like.

A club is inaugurated at the suggestion of the teacher, or perhaps better, at the suggestion of the student. If the group shows enthusiasm—and it will—the first step toward organization is taken. The other steps should take place without delay. A committee should be chosen to draw up the constitution, which in due time will be approved by the members of the club. The teacher might best act as chairman until the preliminary organization is complete. Typical constitutions for science clubs as well as other suggestions are to be found each year in the September issue, No. 2, of the *Science Leaflet*.

The constitution as presented to the club should state specifically: 1. The aim of the organization; 2. Requirements for membership; 3. The officers, their term of office and method of election; 4. The duties and privileges of the officers and members; 5. The time and place of meeting. 6. The financial obligation; 7. Method of amendment; and 8. The authority of the sponsor of the club. This authority should be supreme.

The constitution should be read to the assembled members of the club at least twice during the school year. The first reading will acquaint the members with their duties, and the second reading will serve as a check on the fulfillment of these duties.

Membership to the club should be limited. It might include only students in certain science classes, or students who attain a particular grade average. This will be left to the decision of the adviser of the club, since local conditions are a determining factor. Students wishing to gain admission to the Science Club should be made to express their desire either in writing or verbally. Admission of new members might be left to the decision of the present members. Interest in the activities of the club combined with a willingness to give and to gain knowledge should be the chief prerequisite for membership.

Students who are selected for the position of officers obtain valuable experience. The president and vice-president acquire ability in conducting meetings and in planning and supervising the work of the club. The secretary learns to keep records of the meetings and receives experience in business correspondence. The treasurer profits by the responsibility of handling money and in making out reports of funds received and expended. In addition to the four regular officers the club might elect a reporter whose duty it is to let the school

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The Science of Small-Fire Fighting

● **By William H. Easton, Ph. D.,** *(University of Pennsylvania)*
TECHNICAL DIRECTOR, SAFETY RESEARCH INSTITUTE, NEW YORK CITY

Fire can be extinguished with little difficulty if it is detected soon enough, if proper fire-fighting equipment is available, and if someone at hand knows how to use it.

Above all others, perhaps, teachers should know how to fight fire. If they teach their pupils methods of extinguishing fires as well as means of preventing them, America's fire losses in the future will be millions of dollars less each year than they now are. More important than that, precious lives will be saved.

This paper discusses several kinds of extinguishers, the different classes of fires, and the best methods by which fires of each class may be brought under control.

This is an important article.

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"A little fire is quickly trodden out; which, being suffered, rivers can not quench."
—K. Henry VI, Part III, Act iv, Sc. 8.

The science of fighting large fires is of practical value only to firemen and fire protection engineers, but the science of fighting small fires is a subject that should be taught to every one.

We are suffering today because no one thought it worth while to teach this subject to the last generation of school children. Proof of this is found in the fire record.

From an all-time high in 1926, the fire losses of the United States have been decreasing. In 1926, fire destroyed $562,000,000 worth of property and killed about 15,000 people, whereas the estimated property losses for 1938 were $265,000,000 and the life loss was about 10,000.(1a)

This substantial decrease in our fire losses in 13 years is undoubtedly very encouraging, but, unfortunately, little if any of it is due to a decrease in the number of fires in occupancies controlled by the general public. Last year, fire occurred in 336,000 homes, 2400 schools, and 2500 churches (1a), and these figures are very close to maximums.

On the other hand, by constantly improving its defenses against fire, American industry is constantly decreasing its fire losses. Better building construction and stricter attention to fire prevention play their part in this accomplishment, but as industry has learned that fire will break out in spite of the best of care, it stresses heavily the value of methods and equipment that will prevent little fires from becoming big ones.

What has been done for the industrial plant can also be done for the home, school, church, and small business establishment, but first the public must know how to protect itself from fire, and this is primarily a matter of education.

Instruction in fire protection must cover both fire prevention and fire defense. Most people, however, already know something about fire prevention, since it is largely a matter of good housekeeping and common sense, but there are relatively few who are able to deal with fire effectively should it break out. Hence, the science of small-fire fighting deserves special consideration on the part of the educator.

The Importance of Adequate Fire-Fighting Equipment

Many fires are not detected until they are beyond the control of the average man or woman, but the great majority start as small blazes which could be put out immediately by persons on the spot if they had efficient fire-extinguishing equipment available and were not compelled to fight the flames with ineffective, make-shift weapons.

Proof of this point is furnished by industry. In one large manufacturing plant, for example, from 70% to 90% of all fires starting (and they have hundreds every year) are put out by hand fire extinguishers before any material damage is done.

If this were also true of homes and many other occupancies, our fire losses would be reduced by a large percentage and hundreds of lives would be saved annually. A good fire extinguisher in every home is a condition much to be desired.

But the effectiveness with which fire extinguishers put out fires is not the only reason why they should be generally available.

When a pan of grease, a curtain, or a pile of rubbish catches fire, the first impulse is to attack the blaze with a dash of water, a broom, or anything else that may be handy. Such actions are very natural, but they are also very dangerous as they may bring one so close to the fire that hands may be burned or hair or clothing may catch fire, with serious, perhaps fatal, results.

Moreover, there is danger in breathing the gases given off by fire. An immense amount of evidence indicates that smoke and fumes are much more toxic than their known chemical composition seems to warrant. As one authority puts it, "What then can be the explanation of the frequently reported deaths by inhalation of fire gases? It may conceivably be possible that a combination of gases, each individually in too small a quantity to be dangerous, may through combined action have fatal results."(1b)

It is also very dangerous to throw water on a grease or oil fire. To do so, is to spread the flames and make matters much worse. But with the right kind of a fire extinguisher close at hand, any man or woman can easily put out a small fire while standing at a safe distance and in a safe location.

Classes of Fires

Fire protection engineers divide fires into the following three classes, depending upon the kind of extinguishant required.

Class A fires are fires in ordinary combustible materials, such as paper, wood, textiles, straw, etc.

In extinguishing fires of this class, the chief object is to reduce the temperature of the burning materials, and of those in the immediate vicinity of the fire, to a point below their ignition temperature (which is about 410°F. for white oak, 363°F. for newspaper, and 342°F. for hay). When this is done, the fire goes out and, in the absence of embers, there is no renewal of the flames.

Water is the ideal extinguishant for Class A fires because of its high heat capacity and great cooling effect.

Class B fires are fires in flammable liquids, such as gasoline, kerosene, paints, varnishes, oils, greases, etc.

Water, as ordinarily applied, is not suitable for extinguishing fires of this class, because, in general, flammable liquids float on water and its cooling action is ineffective. Such fires are best extinguished by "blanketing" them,—that is, cutting off the supply of oxygen.

Class C fires cover the special case of fires in live electrical equipment.

As non-distilled water is a conductor of electricity, its use on electrical fires may make conditions worse. In addition, playing a stream of water on live, high-voltage electrical conductors may subject the operator to a serious, and even fatal, shock. Non-conducting extinguishants are used for this class of fires.

Fire Extinguishers

In order to meet a variety of conditions, hand fire extinguishers are made in a number of different types. None of these is considered 100% perfect for use on all classes of fires, but the one that is most commonly used, because it comes very close to this ideal, is the vaporizing-liquid type.

Vaporizing-Liquid Type.—The extinguishant used in this type of extinguisher consists of a carbon tetrachloride base with important components for depressing the freezing point, preventing corrosion, and for other purposes.

A one-quart vaporizing liquid extinguisher of the type widely used for protecting homes and other occupancies, and also motor cars, trucks, and buses.

When this liquid comes into contact with heat it promptly vaporizes, and, as the vapors are heavier than air they tend to settle down, forming a blanket that effectively smothers the fire. This action makes this type of extinguisher effective for use on Class B fires, and, since the liquid is a non-conductor and does not injure metal and insulating materials, it is also approved for use on Class C fires. It will also put out Class A fires, especially those indoors where there is no strong draught.

Small sizes of vaporizing-liquid extinguishers are of the familiar "pump-gun" type and will throw a stream 20 feet long. Large sizes are supplied for industrial use. Because this extinguisher is so versatile, and is easily operated by women and older children, it is ideal for

CROSS-SECTION OF A VAPORIZING LIQUID TYPE EXTINGUISHER

Showing the pump mechanism and the device used to feed the pump from the lowest point of the reservoir, no matter in what position the extinguisher is held.

use in the kitchen and other places where fires of more than one class may be expected. This type is also excellent for use on motorcars, buses, and trucks, since it can deal with all automotive fire hazards and will not freeze at temperatures down to 50°F. below zero. As a recent survey disclosed that 11% of all fires handled by fire departments are car fires, it is evident that all cars should be provided with this protection.

The vaporizing-liquid type extinguisher requires little care or attention except an occasional inspection and the addition of more liquid after test or use. The liquid does not deteriorate; it remains good until used. Only refill material supplied by manufacturers of approved

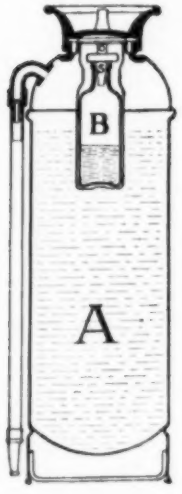
A 2½ gallon chemical-solution type extinguisher, used in schools, theatres, and other public buildings.

extinguishers should be employed since commercial carbon tetrachloride may contain impurities that will render the extinguisher inoperative.

Chemical-Solution Type.—This type of extinguisher

is also known as the soda-acid type and is the type commonly seen in schools and other public and semi-public buildings. It is suitable for use on Class A fires only.

When charged, the tank of this extinguisher is filled with a solution of sodium bicarbonate, and a special glass container, suspended in a cage at the top and provided with a loose fitting stopple, is half filled with sulphuric acid.



CROSS-SECTION OF A CHEMICAL-SOLUTION TYPE EXTINGUISHER

A, soda solution in main body of extinguisher. B, acid in special container. S, stopple of acid container, so designed that, when extinguisher is upright, acid cannot readily splash out, and, when extinguisher is inverted, flow of acid is accurately "metered" to develop internal pressure at the right rate.

In the normal position of the extinguisher, the acid and the bicarbonate solution are kept separate; but when a fire occurs, the extinguisher is carried to it and inverted. The acid then flows slowly out of its container, which, with its stopple, is so designed that the acid is fed into the bicarbonate solution at the proper rate and, in the subsequent reaction, carbon dioxide is produced. The gas develops pressure, which expels the liquid contents through a hose, forming a stream that is effective for distances of from 30 to 40 feet. The extinguishing value of the stream is practically the same as pure water; the purpose of the chemicals is primarily to develop pressure to eject the stream.

Chemical-solution extinguishers must be recharged every year and must not be exposed to temperatures below 40°F.

Foam Type.—Foam type extinguishers contain two solutions, which are kept separate until the extinguisher is put into operation. These solutions are: (1) bicarbonate of soda plus a foam stabilizing agent, and (2) aluminum sulphate. When mixed, a reaction takes place with the formation of sodium sulphate, aluminum hydroxide, carbon dioxide, and water. Physically, the result is the formation of a voluminous foam, formed by the carbon dioxide gas bubbles, the somewhat gelatinous aluminum hydroxide, and the foam stabilizer. The volume of foam is about eight times the volume of the liquids. This foam is expelled through a hose by the pressure created by the carbon dioxide and effectively extinguishes both Class A and Class B fires.

As the foam floats on oil, foam systems are widely used for protecting large oil storage tanks. When an oil tank, thus protected, catches fire, the heat automatically releases the foam, which is quietly poured onto the surface of the burning oil. As the foam spreads, the fire retreats, and when the entire surface is covered the fire is out. This type must also be protected from exposure to temperatures of 40°F. and lower.

CROSS-SECTION OF A 2½ GALLON FOAM TYPE EXTINGUISHER

The soda solution occupies the main (outer) reservoir of the extinguisher, and the special foam-forming solution the inner central reservoir. When the extinguisher is inverted the two mix, the foam forming solution passing through openings which "meter" its flow at the proper rate.

Anti-Freeze Solution Type.—This type is used where extinguishers are exposed to freezing temperatures. The extinguishing agent is a solution of calcium chloride, and the propelling force is supplied by a cartridge containing carbon dioxide under pressure. When the extinguisher is to be operated, it is inverted and bumped on the ground. This action ruptures the cartridge and allows the carbon dioxide to flow out slowly, thereby creating sufficient pressure to form a stream. This type is also approved only for Class A fires. It is also available as a hand pump unit.

Loaded-Stream Type.—In this extinguisher, which is also an anti-freezing type the extinguishing agent is a concentrated solution of a certain alkali metal salt and the propelling agent a carbon dioxide cartridge. This type is approved for Class A fires and also for small Class B fires.

Carbon Dioxide Type.—This type of extinguisher contains carbon dioxide gas under pressure of from 800 to 900 pounds per square inch. In action, the gas is released by turning a valve, and the cloud of gas, mixed with solid carbon dioxide "snow", is directed at the fire by means of a hose with a specially shaped discharge tube. As this gas is heavier than air and will not support combustion, fires blanketed with it go out. This type is approved for class B and Class C fires. Carbon dioxide systems are frequently used to protect large electrical machines and to flood rooms or enclosures containing highly flammable materials.

Good Extinguisher Practice

In the selection and care of fire extinguishers, the following rules of good practice should be followed:

Select the type of extinguisher best adapted to safeguard the given hazard.

Use only equipment bearing an inspection label of a recognized approval authority.

Have extinguishers located so that one can be reached by travelling not more than 50 feet from any point in area being protected.

Recharge as directed by the manufacturer, and use only recharge units furnished by the manufacturer. ●

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1. *Quarterly of National Fire Protection Association.*
(a)—October 1939, page 143
(b)—October 1938, page 95

Outdoor Nature Laboratories

• **By Roy Black, A. B., B. S.,** *(University of Pittsburgh)*
RESIDENT NATURALIST, FRICK PARK, PITTSBURGH, PA.

and J. R. Steck, B. S., *(University of Pittsburgh)*
NATURE EDUCATION SUPERVISOR, BUREAU OF PARKS, PITTSBURGH, PA.

Here is an account of the practical methods one city is using to teach its residents about plant and animal life.

Conductors of field trips in biology will be interested to learn how experienced Park Naturalists conduct large groups on trips through the city parks, what things interest persons on such excursions, and how the leader directs attention to the things that should be seen. The technique is well developed.

Are you one of the teachers who finds himself continually saying "You must not —— ?"

Do you realize that "questions stimulate more interest than explanations?"

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"Study nature not books," is a well known quotation teaching a valuable lesson. Too frequently, this lesson is overlooked and the textbook bears the brunt of the nature study or biology classwork rather than a combination of the textbook and field trips. In Pittsburgh, as in other cities, this failing might be excused by assuming that no suitable field trip areas exist within convenient reach of the schools. Let us take inventory and examine the possibilities of learning the lesson that the quotation teaches.

In the development of Pittsburgh, certain far-sighted individuals gave to the city large tracts of land for park use. As the city grew in area and population these parks served a need in the life of each community. With increased demand by the public, more recreational and educational facilities were offered. Some people enjoy activities of a physical type, others prefer activities of a quiet nature. With leisure time increasing each year, more and more people have availed themselves of park facilities, but unfortunately the parks were being abused. The public did not appreciate the opportunities for recreation set aside in these natural areas, and even the so-called nature lover was responsible for some destruction. The parks were convenient collecting groups for those who wanted specimens. Many of these collections went into discard or were consumed by insects while the plant and animal species in the parks were being depleted. The Park Department wished to encourage the public to use the parks, but at the same time to curb vandalism of the natural features and facilities. The damage done to park buildings, trees, flowers, and animals justifies a program that will overcome this abuse. Park Naturalists were employed to develop certain natural areas in each park that were set aside as wildlife sanctuaries with protection and feeding of the animal life and a planting program to restore the native trees, shrubs, and flowers.

With the program of development and restoration of parks well underway, the next step was the education of the public to enjoy them and to use the parks properly to the fullest extent. Assuming that the logical beginning of such an educational program is with the youth of the community, the Park authorities and the Board of Education established a Park Appreciation Program. Since the parks contain many interesting phases of nature, this new program became a part of the nature class.

A group of park motion pictures, including films on trees, wild flowers, birds, animals and park activities were developed to arouse student interest. These films were shown as an introduction to the parks and the students were then ready for the most important phase of the program—the field trip. The Park Naturalist is anxious to encourage the field trip, for when the classes are in the parks he has the best opportunity to teach park appreciation. A field trip with a Park Naturalist differs greatly from those collecting trips described in the beginning of this article. Instead of just a few individuals, an entire class now has the opportunity to observe nature under his leadership. No specimens can be collected, for other groups will use the same trails and we must share our discoveries with them. In the classroom the pupils study conservation, and out-of-doors they will practice their learning.

In Pittsburgh, there are approximately 1970 acres of fields and woods set aside as public parks. These parks are scattered throughout the entire city, with a major park in each section. At present there are three Park Naturalists, one each in Schenley, Riverview and Frick Parks. These Naturalists are ready to cooperate with groups desiring programs of nature interest. A frequent question asked of the Park Naturalist is, "I have a group that desires a trip through the park. What can you show us that will be interesting?" This type of request may come from a local school, university, science organization, Sunday school classes, Y group, etc.

The Naturalist may meet the group at the car line and call attention to street plantings; their care, need for protection from people, and insect pests. If the group enters the park through a field, attention may be called to birds that nest and feed in the open. There are usually flickers, starlings, song sparrows, and meadow larks to see on the way to the woods. An interesting story of food adaptation centers around the

flickers; a woodpecker with a chisel-like bill capable of digging insects out of a limb, here on the ground digging for ants. Nests of the song sparrow and meadow lark emphasize careful walking when traveling through fields.

Imagine yourself taking the place of a Park Naturalist as he leads a field trip through the park. You may discover a rabbit sitting quietly under a small wild black cherry tree, crouched down in its nest. Since questions stimulate more interest than explanations, ask, "Do you see a rabbit under that tree?" "What structures reveal its presence?" Someone usually answers, "The eyes stand out like big, black buttons." Many may not see the rabbit until it jumps. Another person has discovered a cotton-like mass in the crotch of the wild black cherry tree, "What is that?" Then follows an investigation, and discussion of the caterpillars, the moths that will develop, the bird enemies, and a search by the group for the egg cluster on the end of a twig.

The group now follows one of the park trails, down a wooded ravine, or along a tree-covered hillside. "What identification character do trees have that remains the same winter and summer?" Wrong answers open the way for important explanations. One, perhaps remembering his leaf collections, answers, "leaves." "What happens to the leaves in winter?" The answer, "They fall off." "From all trees?" No. "Do all evergreen trees keep their leaves?" And the discussion centers about the two exceptions: the larch and bald cypress. Someone then may ask, "Well, what character is there that remains the same?" More questioning will result in the answer, "Bark." "Is there a difference in the appearance of bark on young and old trees?" "Why are the leaves sticking on that tree?" That tree is a White Oak. This leads to questions and discussions on food, water, lack of minerals, crowding, and parallel explanations brought out by the instructor in the classroom before the trip.

Underlying every discussion is the thought to build up respect, appreciation, interest, and conservation, without saying, "You must not do this or that," or "Don't ever break off small trees, etc."

In the midst of all this a bird may fly from or to a nearby nest. A woodpecker may alight on a nearby snag. The flicker may start his "hollering", or a cardinal may start to whistle. Perhaps there is a bird chorus. "Do you hear that bird up by that large tree?" Yes. Timing your description of the call or song, isolate that bird from the rest, until every member of the group hears the notes. The bird may fly, or stop singing. Perhaps you can locate the bird later and continue. An imitation, or word description will help in this call or song separation. Good bird pictures help the group find the bird they see or hear.

A cocoon may be found, identified, described and correlated with plants and birds, if possible. Another curious individual may turn over a stone to discover a salamander, centipede, or millipede. Flatworms and crustaceans may be found under the stones in the creek. You may ask, "What animals use these as food?" A discussion of the purple grackle turning over the stones may follow. "There are racoons in the park. What evidence have they left behind?" Tracks in the mud, a pincher or two, and part of the tail from a crayfish on a rock or nearby stump. Many squirrels, perhaps a groundhog, or a snake or two, will all serve to aid the group in recognizing the relationships between the various forms, and the necessity for their care and protection, if all are to be enjoyed as intended.

A class prepared to observe trees may spend the entire time watching a flock of migrating warblers. Another group may study trees or wild flowers that bloomed over the week-end, when they planned to study the habits of nesting birds. It is usually the teacher that says, "Time is up. We have just ten minutes to make the next class." But many a class has been late because all were so interested that watch time had ceased to exist.

Achievement? Classroom discussions and reports that are enthusiastic and real. The park behaviour of those individuals, who have become interested because of these planned field trips, is noticeably different. They use but do not abuse. ●

Chicago Science Group Holds Meeting

Over one hundred delegates from the local universities, colleges and high schools attended the eighth meeting of the Chicago Catholic Science Teachers Association held at Alvernia High School, Chicago, on Wednesday, December 27, 1939. At this meeting ten new high schools were represented for the first time.

The meeting opened with a lively general business discussion. A new feature, the Informal Meeting Period, wherein members discussed privately various teaching problems, was productive of much good. The afternoon sessions were given over to sectional meetings. In the biology section, Rev. Hilary Jurica, O.S.B., led the discussion with the timely topic, "Conservation." "The Hypothesis in Physics" was the topic Rev. Richard Sonka, O.S.B., discussed before the joint meeting of the physics and chemistry sections. Round-table discussions of present problems closed the sectional meetings.

The next meeting of the Association will be held at Mallinckrodt High School, Wilmette, Illinois, on Easter Monday, March 25, 1940.

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Science Teaching Aids

The American Institute of the City of New York, Lincoln Building, 60 East 42 St., New York City, announces the following subscription rates for two of their publications which are devoted to the interests of high school science pupils:

The Science Observer, fifty cents a year.
The Science Leaflet, $2.00 a year.

If both publications are subscribed for, rates of thirty-five cents and $1.80 apply.

These journals should be in the hands of all students of secondary school science.

Rayon, Synthetic Textile

• By J. Bracken Johnson, B. S., *(Duquesne University)*
NEW BEDFORD RAYON COMPANY, NEW BEDFORD, MASSACHUSETTS.

Mr. Johnson, research chemist for an important manufacturer, tells a story about rayon that is the result of actual contact and observation. He discusses the different varieties, the several methods of manufacture, and the many special uses to which this man-made textile fiber is put.

Has rayon supplanted other textiles, or has it made a new place for its own? Why are tire manufacturers and yachtsmen interested in rayon development? Have prices gone down? What of the future?

Mr. Johnson answers these questions and many more.

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Rayon, the man-made fiber that has become one of the most important materials in the textile world, is the result of years of patient scientific research.

As long ago as 1644, Dr. Robert Hooke, eminent British scientist, made the prediction: "Silk equal to, if not better than that produced by the silkworm will be produced by mechanical means." Through the years that followed, Reaumur, Audemars, Hughes, Evans, Crookes and others labored in vain to find and perfect a process of "silk" making that would be commercially successful. But it was not until 1884 that Count Hilaire de Chardonnet, of France, took out his first patent on a successful rayon filament, bringing to fruition the efforts of all his distinguished predecessors. For this he is known as the "Father of the Rayon Industry".

Historical Background

Following Chardonnet's first patent for making rayon by the nitro-cellulose method, many important developments were made. By the beginning of the 20th century, all four of today's methods of producing rayon had been discovered. Most important during this time from 1884 to 1900 was the work of Messrs. Cross and Bevan of England in the discovery of the viscose process which now is the most widely used method of rayon manufacture. These men also did research and obtained the first patent on the cellulose-acetate method, but considerable refinement and a great amount of the development of this method of manufacture must be credited to Drs. Camille and Henri Dreyfus in Switzerland. The fourth method of producing rayon, the cuprammonium process, was first announced by the French Dispeisses in 1890, but, as in some of the other methods, it was the continued work of another which really put it on a commercial basis, and for this reason Dr. E. Elsaesser in Germany must be mentioned.

From this brief historical sketch one can see that the original idea was conceived and most of the initial research done in Europe, particularly by the French and British. However, later technical improvements were contributed by the United States, Germany and Italy, with the United States becoming a leader in production on a vast commercial scale. The first attempt at rayon manufacture in the United States was the establishment of a plant at Lansdowne, Pa., about 1904, by the General Artificial Silk Company. This concern finally went bankrupt and with the purchase of the patent rights by Courtaulds Ltd., of England, the first successful commercial plant was established in 1910 at Marcus Hook, Pa. under the name of "The Viscose Company of America."

Methods of Manufacture

The cellulose acetate method of manufacture is the only one that does not have regenerated cellulose as its end product, the finished yarn in this case being the chemical compound cellulose acetate. All four methods use some form of cellulose as a base, usually cotton linters or a very pure form of wood pulp having a high alpha-cellulose content. The underlying principles in all processes are to convert the cellulose into a soluble form by chemical treatment, dissolve it in a suitable solvent, force this solution through minute orifices, and then precipitate the cellulose from solution in the form of fine filaments. These are subsequently washed, bleached, and dried to give a finished rayon. The execution of these principles, however, is not as simple as it sounds. It requires a very stringent control of concentrations, temperatures, and reaction times throughout the entire process to produce a satisfactory product.

In the Chardonnet nitro-cellulose process, the purified and bleached cotton linters are steeped in a mixture of nitric and sulphuric acids. When the nitration is complete, the "nitro-cotton" is washed and extracted to remove all traces of acid. This treated cotton is then dissolved in a mixture of alcohol and ether to form a viscous solution which is forced through jets or spinnerettes with minute openings. The solution of cellulose being emitted from these openings is coagulated almost instantly by the evaporation of the ether and alcohol. These strands of yarn are reeled into skeins and treated with a denitrating solution that renders the yarn uninflammable; the untreated freshly spun yarn has this undesirable characteristic. The usual procedures of washing, bleaching and drying are carried out, and the finished yarn is inspected for the removal and segregation of imperfect rayon before being packed for shipment.

In the cellulose acetate process, purified and bleached cotton linters are allowed to react under controlled temperatures with an acetylating mixture consisting of approximately equal parts of acetic anhydride and gla-

cial acetic acid plus a small amount of concentrated sulphuric acid. The primary acetate thus formed is a heavy viscous solution and must be hydrated into the secondary acetate by dilution with equal parts of concentrated acetic acid and ten per cent sulphuric acid and by standing at an elevated temperature for approximately fifteen hours. The hydration is stopped at the desired point by precipitation of the secondary acetate in cold water in the form of flakes. These flakes are washed and dried and then dissolved in chemically pure acetone to give the spinning solution which is forced through minute orifices as in all processes. The filaments of cellulose acetate are coagulated by the evaporation of the acetone solvent by a current of hot air. The strands of yarn are wound on a spool or some such collecting device, to be subsequently twisted and packaged before shipment to the weaving or knitting trade.

The cuprammonium process also uses purified and bleached cotton linters as a base. These are dissolved in a solution of basic copper sulphate and 28 per cent ammonia water to give a thick viscous solution. This solution is diluted with water to give a viscosity and a cellulose content suitable for spinning. The spinning solution is, as usual, extruded through the small holes of a spinnerette to form the fine filaments of cellulose which are coagulated and collected on a winding device. In this process we find the cellulosic solution is precipitated by passing the filaments through a bath. This is known as a wet spinning process in contradistinction to the dry spinning process of the nitrocellulose and cellulose acetate methods. For cuprammonium rayon the spinning solution, as it emerges from the spinnerette openings, passes into a glass funnel through which soft, de-aerated water flows under controlled temperatures. From the funnel the filaments are passed through a weak sulphuric acid solution to the winding reel, and after washing and drying, the skeins of yarn are ready for shipment.

The fourth method of producing rayon, and the most widely used, is the viscose process. In this, highly purified wood pulp in sheet form is soaked in an 18 per cent solution of caustic soda. The excess caustic soda is then pressed out until the mercerized wood pulp is approximately three times its original weight. The pulp is then cut into a fine, white mass in a machine that has huge revolving knives and in which the temperature is controlled. The fine fluffy mass, now known as alkali cellulose or "white crumbs," is placed in airtight containers and allowed to stand in a temperature-controlled room for a certain period of time in order to age. Aging time and temperature are the chief controlling factors of the viscosity of the spinning solution.

After the required aging, the alkali cellulose is allowed to react with carbon bisulphide in an airtight revolving drum for a certain time during which the temperature is again controlled. The converted wood pulp in its passage along the road to become rayon has now assumed a bright yellow, or yellowish-orange color and is called sodium cellulose xanthate or "yellow crumbs". The xanthate is immediately mixed and dissolved in a dilute solution of caustic soda to give a solution of cellulose which must be filtered and allowed to age before it can be used to spin rayon. After the required maturing or ripening, the cellulosic solution, as in all methods, is extruded through the spinnerette orifices and after coagulation is collected on some type of winding device.

The viscose method uses a wet spinning process, and the precipitation or coagulation of the cellulose is accomplished by passing the filaments through a dilute sulphuric acid bath containing some soluble sulphates such as ammonium, sodium, magnesium or zinc. The freshly-spun yarn contains sulphur impurities formed during the spinning reaction which must be removed. This is done by treating the yarn usually with ammonium or sodium sulphide solutions. After washing, bleaching and drying, it is ready to be inspected and packed for shipment to the trade.

Distribution of Rayon

Up to this point all four major methods of manufacture have been different, but now, with the final inspection of the yarn to remove any imperfections and the packing for shipment, they converge into common channels. The two important outlets for any type of rayon yarn are the weaving and knitting industries which are too broad in their scope to permit any description of either in this article. In these two industries the rayon yarns are converted into many types of piece goods either woven, such as dress goods material of taffetas, satins, or velvets, or knitted such as hosiery or undergarments.

One interesting thing that should be pointed out is that yarns from one type of manufacture are never mixed with yarns from another type nor are yarns from the same type of manufacture, but from different mills, placed in the same piece of goods. This is due to the difference in dye absorption of yarns of different processes, and of the same process but from different manufacturers. There is one notable exception. This is the interesting item referred to previously, wherein cellulose-acetate rayon is mixed in the same goods with any of the other three regenerated celluloses to give a cross-dye effect. By the selection of the proper dyestuffs, the goods may dye leaving the cellulose acetate yarn white while coloring the regenerated cellulose yarns, the opposite effect may be obtained, or the resultant cloth may have a two-toned effect. This peculiarity of dye affinity, not only among rayons but also among wool, silk, and cotton and mixtures of any or all of these, is advantageously used by cloth manufacturers in developing new and unusual-looking material.

Another recently discovered use for rayon is in making yarn for automobile tires. Due to its greater strength under heat, and the fact that rayon is a continuous twisted filament, tires of greater strength and durability can now be made to withstand better the rigors of present day high speeds and heavy loads. A small but interesting outlet is the use of rayon for boat sails to replace the heavy cotton ones; this was pioneered by Commodore Vanderbilt when he used sails of

this material in the last International Cup Defense against Great Britain.

All of the foregoing uses for rayon yarns have dealt specifically with the original or continuous filament type of yarn, whereas in the past few years this continuous filament yarn from any one of the four processes, particularly the viscose and acetate, has been augmented by what is called staple fiber rayon. Here the continuous filament yarn is cut into the desired lengths similar to cotton staple fibers, either at the time of coagulation or later in the process. This staple fiber rayon is then made into yarn in the same manner as cotton or wool, and it is then converted into cloth giving many novel effects. Recently, this type of manufacture has made tremendous strides and represents a good percentage of the big increase in rayon production in recent years.

Economic Background

In conclusion, a review of the production of rayon showing the great increase in manufacture of this synthetic textile since its beginning will give the reader some idea of the big advancement made in this young industry, mainly through the untiring efforts and research of the chemists, physicists, and engineers. Their contribution will also be reflected in the reduction of the price of rayon during these years which have seen rayon changed from a novelty fiber or scientific curiosity to a commercially important yarn.

In 1890, the total world production of rayon was thirty thousand pounds, whereas, for 1938 the poundage had increased to 1,900,000,000, of which 975,000,000 pounds were filament yarn and 925,000,000 pounds were staple fiber. The production of filament rayon in the United States was 363,000 pounds in 1911 and for 1938 it was 258,000,000 plus about 30,000,000 pounds of staple fiber. The year 1938 does not, however, represent the highest peak of rayon production, for in 1937, the greatest year, showed 322,000,000 pounds of filament yarn plus 20,000,000 pounds of staple fiber. For the year 1938, the United States produced about twenty-six per cent of all the rayon filament in the world, but only about three per cent of the staple fiber. Japan continues to be the largest rayon producing country in the world with a total production of both filament and staple fiber yarns of about 550,000,000 pounds in 1938; this total represents about twenty per cent of the world filament yarn production and about thirty-five per cent of the world staple fiber production. It has been only since about 1934 that Japan has attained the top ranking position, and this was chiefly because of a tremendous increase in staple fiber yarn production. Prior to 1934, and since about 1920, the United States had been the leading producer.

The history of the price of medium size or standard yarn is an interesting item. In 1911 yarn was selling for $1.85 per pound, and continued at that figure until 1914 when the price was increased to $2.00. After this there was a steady rise each year until in 1920 rayon sold for $6.00 per pound. This fabulous price was of short duration, however, and by the end of that year rayon was marketing at $2.50. From 1921 until the present time the price gradually became lower because of new refinements in manufacture and the advent of many new producers, so that, today, the price is fairly well stabilized at $0.50 to $0.60 per pound.

To what extent has rayon supplanted other textile fibers? A study of the annual fiber consumption figures for the United States from 1920 through 1938 will answer this. In 1920 cotton represented 89.6%, wool 9.2%, silk 0.9%, and rayon 0.3% of a total consumption of 3,150,000,000 pounds. In 1938 cotton was 81.6%, wool 7.7%, silk 1.5%, and rayon 9.2% of a total consumption of 3,550,000,000 pounds. Even though on this percentage basis the increase in rayon consumption has been mostly at the expense of cotton, it does not necessarily mean that the consumption of cotton has declined. Cotton consumption has remained about the same, but the introduction of rayon on a large scale has been reflected in a greater total consumption of all types of fibers. This means then, that rayon, instead of substituting for another fiber already existing, has itself created a new field in the textile world. As a closing remark and to give the reader something tangible for visualizing the amount of rayon yarn produced, bear in mind that in each pound of medium-sized rayon there are 29,763 yards of thread, but I will leave it to you to calculate how far a year's production would extend into space, or would encircle the world. ●

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Delayed Congratulations

On page 97 of the December, 1939, number of the *Science Counselor*, in connection with an article on the Science Fair in New York City, we published a picture of one of the prize winning exhibits of last year. At the time of going to press we did not know what school had exhibited the model. To a teacher in a Catholic High School in Kentucky who had attended the Fair we are indebted for the information that the exhibitor was the Chaminade Bio Club of the Chaminade High School, Mineola, L. I., a school conducted by the Brothers of Mary. The club moderator is Brother Joseph Kuntz, S.M. Congratulations! We are glad to give this credit to a Catholic High School that has captured prizes in former years also. The model shown in the picture referred to, won first prize in its class as well as one of the three special awards for creative ability.

We hope that Brother Kuntz's pupils will be as successful with their 1940 exhibit.

NEW BOOKS

Photograph by Robert Turriff Hance

Interpreting Science

By FRANKLIN B. CARROLL, Frankford High School, Philadelphia. The John C. Winston Co., Philadelphia. 1939.

UNDERSTANDING OUR ENVIRONMENT, Book I, x + 438. $1.48

UNDERSTANDING OUR WORLD, Book II. xi + 554. $1.56

UNDERSTANDING OUR UNIVERSE, Book III. *By* FRANKLIN B. CARROLL, FRANK A. REXFORD, Museum of the City of New York, and HENRY T. WEED, Girls' Commercial High School, Brooklyn. xx + 712. $1.68

This series of junior high school textbooks is unusually well planned and well executed. Both teachers and pupils should enjoy using them. The interests of pupils of grades 7, 8, and 9 have been considered in the selection of subject matter and in apportioning it among the books. Each of the 37 units has an interesting preview; each is divided into chapters. There are numerous suggestions for study, for vocabulary building, and for self tests. Provision has been made for individual differences and for local needs.

The how and why attitude is encouraged. Very definite attempts have been made to inculcate the scientific method, to make the pupil think and reason logically, and to tie up science with daily living. Hundreds of new and fresh drawings, diagrams, and photographs, and a few color plates, carrying interesting and provocative legends, illustrate and supplement the text. A large number of experiments for demonstration and pupil use have been included. The books are well made mechanically.

The writers of this series have done a good job. These books should be considered wherever new adoptions are being planned.

Our readers will be interested to know that it was Dr. Carroll who wrote the stimulating article "Choosing a General Science Textbook" which was published in our June, 1939, number.

H.C.M.

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The Microscope

By R. M. ALLEN, D. Van Nostrand Co., Inc., New York. 1940. viii + 286. Illustrated. $3.00.

This well written, well bound, and well illustrated book is a practical treatise on the microscope, designed for those with insufficient technical training to enable them to understand the advanced mathematics of optical science. The author states that he hopes that the book will supply information not available in any other single volume, that it will aid in improving the technique of present users of the microscope, and that it will encourage others to take up the work.

Optical principles are treated in a simple manner, all but essential formulae being omitted. There is a brief history of the microscope. Modern instruments are discussed, and the advantages and limitations of instruments of different design are pointed out. There are chapters dealing with illumination, methods of testing objectives, and procedures for preparing different types of materials for microscopic examination. The chapter entitled "Getting the most out of the microscope" contains hints valuable to the experienced worker as well as to the novice.

A bibliography covering most of the modern books on microscopy published in English, and a glossary of words in common use among microscopists are valuale features of the book.

E.V.

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Physics Work Book

By M. H. BUELL, Senior High School, Ann Arbor, Mich., and F. W. SCHULER, West High School, Madison, Wis. J. B. Lippincott Co., New York. 1939. 378 pp., 190 figures. $1.00.

This book is a combination of condensed high school physics text, laboratory manual, exercise book and guide for special study. It is divided into eleven "units" representing divisions of the subject. Each unit opens with a very brief introduction, after which follow a list of references to nine high school textbooks of physics; a number of "problems" (explained below) and experiments; and lastly, a section, "unit activities", consisting of review questions, suggested projects, topics for reports, and a list of "self-help" questions of the "completion" type. Separate lists of examination questions are furnished for the teacher's use in testing the student after completion of each unit.

The "problems" are topic or section headings put in the form of questions. Each is developed by a combination of brief exposition, questions, directions for demonstrations, and test questions of the "completion" type. These developments as carried through give a distinct impression of choppiness because of the mixture of devices used to convey or induce the ideas. But if used as a follow-up of regular textbook assignments, as the authors intend, they should prove satisfactory.

In all, fifty-seven experiments are described. The instructions are clearly written and are accompanied by well drawn diagrams, where necessary. Forms to use in recording the data and results are given. Unit tests are provided in booklet form.

The book as a whole is attractively composed and well printed. The covers are paper. It should appeal to the student who is scientifically worth appealing to. It is a worth while contribution to our available helps in teach- high school physics.

G.E.D.

Excursions In Science

Edited by NEIL B. REYNOLDS, General Electric Company, and ELLIS L. MANNING, Supervisor of Science, New York State Department of Education. Whittlesey House, McGraw-Hill Book Co., Inc., New York. 1939. xiii + 307. $2.50.

That men can write most interestingly about the things they know best is evidenced again in this out-of-the-ordinary book.

Thirty important scientists, for the most part connected with the research laboratories of the General Electric Company at Schenectady, or members of the faculty of Union College, discuss the important and underlying facts of their own specialties. They consider such topics as atoms, time, lightning, meteorites, vacuum, odors, earthquakes, metals, tides, stones, radio tubes, heredity, and archaeology. Their simple and clear explanations are addressed to laymen, not to scientists, as might be judged from the fact that the book is the outgrowth of a series of radio programs.

Teachers of science should not fail to read this book. High school students will find that much of its material is not beyond their grasp.

J.F.M.

●

Science Experiences With Inexpensive Equipment

By C. J. LYNDE, Professor of Physics, Teachers College, Columbia University. International Textbook Company, Scranton, Pa. 1939. xiii + 258. Illustrated. $1.60.

The publication of a book by Dr. Lynde is an event in the lives of teachers of the physical sciences, especially those who have limited budgets. His first book, Science Experiences with Home Equipment achieved wide popularity, deservedly so. The present volume, second of a series of three, follows the plan of the first book. Its experiments are a little more difficult to perform. In all, two hundred experiments are described, illustrated by line drawings, and explained. All the apparatus required can be purchased for a few cents.

No high school student could fail to be interested in experiments that show him how to curve a baseball, how to find the "best spot" on the bat, how to lift a teacup with a balloon, how to remove a cork without touching it, how to boil water by cooling it, how to make smoke rings, a bottle that smokes, an imitation snow storm, and a hiccup bottle.

Every budget is large enough to include this book.

H.C.M.

●

Chemistry and You

By B. S. HOPKINS, R. E. DAVIS, H. R. SMITH, M. V. MCGILL and G. M. BRADBURY. Lyons and Carnahan, New York. 1939. xi + 802. Illustrated. $1.35

This is one of the most interesting of the newer books, written by experienced teachers who understand high school pupils as well as the science of chemistry. The authors use a somewhat different approach and a clear, simple and stimulating style. They do not hesitate to employ attention compelling phrases such as "super-oxygen", the "finger prints" of elements, metals that are "hangouts" for hydrogen, and oxygen for that "dopey" feeling. The book is up to date in its consideration of isotopes, heavy water, hormones, vitamins, etc., but it does not disdain drano, crisco, newskin, and the ring around the bathtub.

The principles of the psychology of learning have been observed throughout. Chemical principles and generalizations have everywhere been emphasized. Bibliographies become "Reading for pleasure and profit". Lists of mathematical problems are headed "How good are you at solving problems?" Under the title "Applying in life what you have learned in chemistry" are given circumstantial accounts of real life happenings or situations for the pupil to explain or criticize or solve. Practical questions of a varied nature appear under "Putting chemistry to work." Illustrations, type faces and selection, arrangement, paper and binding are examples of good book making

Studying, not reading, this book is recommended to all who teach chemistry. It should make better teachers of them, especially of those who may have fallen into a teaching rut.

The accompanying laboratory manual, "Chemistry and You in the Laboratory" follows the textbook and is on the whole just as satisfactory.

H.C.M.

●

Introduction to Animal Biology

By JOHN B. PARKER and JOHN J. CLARKE, Department of Biology, The Catholic University. The C. V. Mosby Co., St. Louis, 1939, 503 pp. Illustrated. $3.75.

The authors of this recent book on Zoology have, with entire justice, maintained that another general text is warranted when a fresh organization of material is presented. This Dr. Parker and Dr. Clarke have done with no little courage. This new book, developed strictly along the older phylogenetic lines, illustrates each phylum with the minimum number of the best known representatives. This avoids the possible confusion arising from presenting too many variations of the common type. The discussions of the traits of thirteen phyla is concluded with twelve pages on gametogenesis, twenty-two on heredity and three on evolution. There is no distinction drawn between the accomplishments of Mendel and of those whose work has been more recent. The writers of this book have a tendency to develop unusually long and involved sentences which they would do well to correct in future work.

R.T.H.

●

Growing Plants In Nutrient Solutions

By WAYNE I. TURNER and VICTOR M. HENRY. John Wiley & Sons, Inc., New York. 1939. xiii + 154. Illustrated. $3.00.

This is an up-to-date handbook for the commercial grower as well as for the amateur gardener and the research worker.

The authors, who have had first hand experience, supply valuable information that has heretofore been inaccessible to many persons because it has been so widely scattered. They write a language that the layman can understand, giving detailed information of the most practical nature.

They discuss the commercial advantages of nutrient solution culture as well as its small scale applications. They describe equipment and give formulas. They tell of failures as well as successes. They show how to test the solutions used and how to know from the appearance of plants when certain necessary materials are either lacking or present in too great amounts. Seemingly, everything that the worker needs to know is told.

We doubt if you can read this book without being tempted to begin experimenting at once.

J.F.M.

Mechanics

Sub-title, "Industrial Physics". Second Ed. *By* L. RAYMOND SMITH, William L. Dickinson High School, Jersey City, N. J. McGraw-Hill Book Co., Inc., New York. 1939. xiv + 229. $1.75.

This little book, first published in 1922, succeeds admirably in presenting mechanics in a manner that is at once simple and understandable. It seems to be just what the author intends: "a textbook suitable for use in technical, industrial, vocational, and evening schools". The diagrams are well drawn, and the questions and problems well chosen and of about the proper degree of difficulty for a book of this kind.

Some topics in the introductory chapter, on the structure and properties of matter, might well be treated less briefly. A few statements should be made more accurate and complete. But these are minor defects, easily corrected by the teacher who uses the book as a text and detracting little from the general appropriateness of the presentation.

G.E.D.

Field Book of Animals in Winter

By ANN H. MORGAN, Ph.D., Mt. Holyoke College. G. P. Putnam's Sons, New York. 1939. xv + 527. Illustrated. $3.50.

A distinguished addition to an already distinguished series on Nature Field Books previously published by Putnam's Sons, has been written by Dr. Ann H. Morgan, Mount Holyoke College. This book, intended for amateur and professional alike, begins with a six-chapter discussion of the ecological conditions introduced by the onset of winter. In the nineteen succeeding chapters the representative members of the phyla, from sponges to mammals, are discussed with a thoroughness and brevity that is delightful in this day of extra-volumned editions. This book should be on the "must" list of all teachers of biology, of nature study, and of those who just like to know a great deal more of curious facts about many curious creatures.

R.T.H.

To Learn Science

Continued from Page Five

The Teacher Can Make the Student Want to Learn

Having shown the need of making the student see the worthwhileness of the subject, and having presented a few aids to interest and a few of the pressing problems, we are now ready to answer the original question expressed in the title. *The student can be made to want to learn.* Science is so inherently interesting, that the task is mostly done for us. Only in those cases where the natural curiosity of the child has been stifled until it has died out, has the teacher a chance of failure. The failure results because in the years of adolescence social interests press in so hard that the dormant scientific curiosity cannot be revived. Some of the interest stimulation can come from supplementary reading. A good choice of reading assignments is one of the most important helps the teacher can use. By keeping the goal constantly in mind the teacher can make the student like to learn. ●

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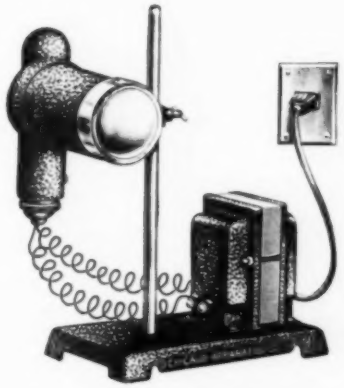

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Biological Drawings

Continued from Page Eleven

Having drawn this all-important first line down the middle of our page of paper it is now well to envision a drawing of the object as though completed. The value of this use of the imagination cannot well be overrated. It is one used by artists, architects and designers.

While our first line determined the longitudinal axis of our sketch the next few should be transverse. One may now estimate the full size of the finished sketch and determine the scale, whether natural size (1/1), twice natural size (2/1), or otherwise. Allowing for the extension of the chelipeds anterior to the rostrum the draughtsman should next draw a short line to indicate either the position of the tip of the rostrum or, better, the posterior borders of the orbits. The second transverse line should place, after measurement with a celluloid scale, the posterior border of the telson. With these three lines set down all matters of proportion become pre-determined. For example, the width of the object is no longer open to argument for it becomes a ratio of body length.

The methods to be employed from this point onward will depend upon the student and it is unwise to insist that everyone work in precisely the same way. But this one rule may be held as invaluable — that *decisions should be made in the order of their importance.* In other words, sift all decisions involved in this entire task, giving no attention to a smaller one until a larger or more inclusive principle has been reckoned with.

To go on with the drawing, I should next look for the most important crosswise line between rostrum and telson. All would agree that it is the line separating cephalothorax from abdomen and the proportionate spacing in the relative lengths of these two regions becomes a matter of judgment. This line is further significant as it separates the region of evident metamerism from that in which segmentation is obscured. The next cross mark locates the cervical groove. We may now mark off the seven joints of the abdomen. To do so I should first delimit the telson and then place a line at the posterior border of somite 3, after doing which it is easy to mark off abdominal segments 1 and 2 in front and 5 and 6 behind. We are now ready to establish *widths* for carapace, abdomen and tail fan. Do this constantly imagining how the whole sketch will *look* when finished. Now is the time to avoid too thin or too plump an appearance of the completed sketch. The relation and posture of each appendage, including antennae, might now be laid down in light curved lines, each merely indicating the axis of the part. Mark off their ends and, with cross-lines, show the limits of each podomere.

Up to this point there should be no *outlines.* Most students, even in college, draw by outline, but this is wrong. It is always better, after general placement of axes and limits, to draw by *masses.** Survey the crayfish now from this standpoint. Our drawing of the animal can show only how it *looks* from some one selected aspect, not how it actually *is*, and one should not worry about doing the impossible. From this standpoint, as to how the drawing may be made to represent the creature as it appears, seek out the component *mass units* presented. These geometrical mass units include the sphere, the ellipsoid, the cylinder, the cube, the pyramid, the cone. Note that the cephalothorax is an ellipsoid, the abdominal segments modified cylinders, as are also the podomeres, while the antennae are very tall cones. The stalked eyes are ellipsoids mounted on cylinders. With this principle of mass construction in mind now draw in the various parts, adding modifications and details as they may be found necessary.

An important and generally neglected factor in drawing hangs upon the artist's conception of "line". Take the pencil easily in the relaxed hand, not too near to the point, and let it sweep in easy curves over the paper. Note that, with the fingers, smaller arcs are readily described; with the whole hand larger ones; and with the forearm, some of greater radius. Learn to free hand, arm and mind so that, to an extent, the spirit is released to do the work! Just as in dancing, singing, or playing an instrument, the body must be free and relaxed to be obedient to the spirit of the thing, so here, while "there is no excellence without great labor" it is equally true that one should not be "careful over much."

In making a drawing the student should be instructed to remove the sheet of drawing paper from his notebook and turn it in any position he cares to in order to inscribe lines with the greatest facility. All lines ought, at first, to be made lightly and later sharpened or intensified as may be found necessary. In finishing a drawing keep in mind the fact that lines may be expressive and so look better when made stronger or lighter in places. It is well to conceive the source of light as coming from the upper left hand corner of the paper, in conformity with which principle of illumination lines to the right and below should be drawn slightly darker or heavier than those to the left and above, in the delineation of any part or structure.

While the student does well not to use too soft a pencil on account of smudging, the opposite extreme—of using too hard a pencil—is equally bad as it is both unnatural and also discouraging because too little effect is produced. I find a No. $2^1/_2$ pencil about right. It should be kept fairly sharp, preferably with a good pocket knife, for I have never found a pencil sharpener which can approach good hand-sharpening. Finally, I would say, do not attempt shading—unless you are an artist.

After a little guidance and practice in the method of drawing above described many students will find their work becoming agreeable if not delightful. This method reduces worry and puts an end to that constant erasing which is the sign of confusion of mind if not of frustration. The student soon discovers that study by means of drawing means a definite program in the making of decisions and that insight is fostered by practice in doing tasks in a logical order. As we direct our students to make drawings of plant and animal structures in the

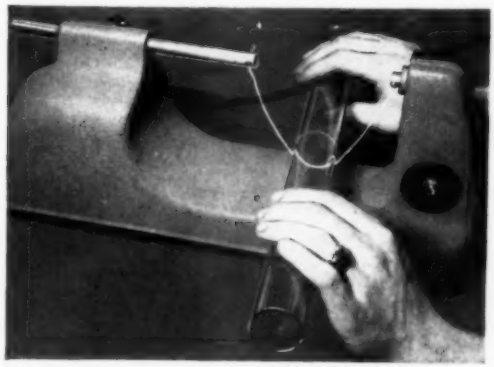
*Cf. Mueller, J. F., 1935. *A Manual of Drawing for Science Students.* Farrar and Rinehart.

laboratory it is well to reflect that it is all-important to observe *how* they do this kind of work and to guide them in methods which will result in their educational advancement.

In conclusion, it may be unnecessary to point out what has been implicit in this entire discussion—that, primarily, we do not teach students biology in order to make biologists out of them but, rather, that we may develop in them insight and capacity for the work and play of life by the use of available and significant material from the world of living things. ●

Hot Wire Glass Cutter

A new laboratory appliance that cuts glass tubing, cylinders, plates and similar glassware with a sharp, clean break perpendicular to the length of the tube. The danger of the older cutting methods is avoided.



Courtesy Fisher Scientific Co.

To Project Through an Ordinary Microscope

Bend the microscope at its hinge so that the tube is parallel to the table.

Remove the eyepiece.

Adjust the shade and lamp of a "goose-neck" desk lamp so that the rays of light are thrown directly through the slide and into the objective. It is best to use a 100 watt bulb, although I have obtained a fair image with 40 watts.

Throw a black cloth over the lamp and microscope so as to exclude stray rays of light from reaching the screen. A piece of white cardboard will serve as a screen.

For best results the screen should be in a dark room and not too far away from the microscope. With a 40 watt bulb I was able to get (at about 30 inches) a moderately bright image in a room that was not darkened. A 16 mm. lens was used without an ocular, and produced a circle of light about 8 inches in diameter.

To better shield the source of illumination, the desk lamp and microscope may be put into a card board carton with only the eyepiece end of the microscope projecting through a closely fitting hole in the box. The open side of the box should be curtained with black cloth.

This outfit takes but a few minutes to set up. It permits only eight or ten students at one time to view the results. However, few microprojectors, except the very expensive ones used under very favorable conditions will do much better. ●

R.T.H.

Fisher Universal Fluorescent Lamp

The Fisher Universal Fluorescent Lamp has unique features that enable it to be employed advantageously for such operations as color matching, reading of burettes, analytical weighing, and many others. It has an adjustable reflector and a removable supporting arm with Castaloy Clamp Holder by means of which it can be attached to a burette stand, Flexaframe Support or similar apparatus.

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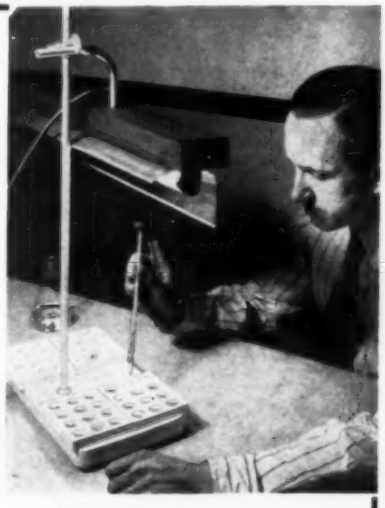
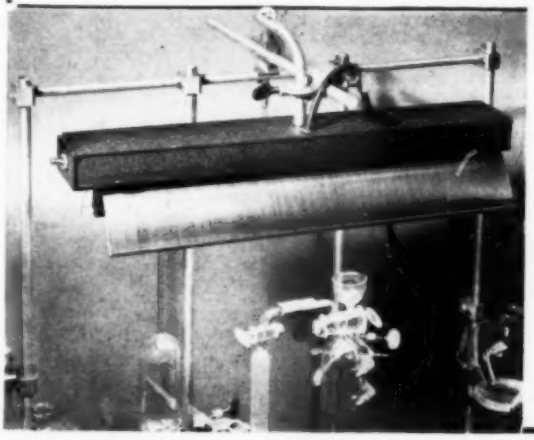


Color matching is more accurately conducted when the Fisher Universal Fluorescent Lamp is employed.

The new lamp is readily attached to a Fisher Flexeframe to illuminate any assembly of apparatus.



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Science Club

Continued from Page Twelve

know what the club is accomplishing. Recognition of the work done by the science department can, and should, be gained through the school paper.

A club can scarcely accomplish the end for which it was organized without at least some money. This can best be met by assessing each club member a definite sum to be paid before a fixed date, as determined by the constitution. Members failing to pay dues should neither hold an office nor have any voice in the club.

For obvious reasons the meetings should be conducted according to parliamentary procedure. A few fundamental rules, as for example, calling the meeting to order, addressing the chair, introducing a motion and amending a motion can be quickly learned. This alone will give the student a training that will enable him in later life to take part in meetings with grace and effectiveness and without embarrassment.

One of the greatest difficulties to be met in club organization is the securing of a time of meeting when all the members can be present. If the school program can be so arranged that one day a week is set aside for the meeting of clubs the situation is simplified, providing that the students are not members of different clubs meeting at the same time. Meetings held after school hours are less satisfactory than those held during school hours. The students as well as the teachers have other duties at that time and a meeting not well attended is a failure. If all members can be present, the regular class period is perhaps the best time for meeting. The other alternative would be to have the club function in units or sections with a chairman at the head of each section.

Care must be taken that the student is not a member of too many clubs and other organizations. Extra-curricular activities should not be pursued to the detriment of his curricular duties.

Interest in the club will be maintained and some prestige gained by affiliation with a state or national organization. A Bird Club can join the National Association of Audubon Societies in New York. Other clubs can affiliate with the state Junior Academy of Science or with the Student Science Clubs of America. There are at present over seven hundred and fifty clubs throughout the United States affiliated with the latter.

Dr. Karl Taylor Compton, president of the Massachusetts Institution of Technology, also president of the Student Science Clubs of America, says: "This science club movement has a real opportunity to be one of the greatest educational forces in the country."

To be successful organizers and leaders in club activities, however, we ought ourselves to be active members in one or more science organizations. If such organizations do not exist in our community we ought to form them.

Our present science students are our future science teachers, many of them Religious, we hope. It is our part as Catholic educators to direct them now in forming organized groups that they may continue to carry on this great work, championed by the Church, the pursuit of science. ●

Science Experiences

Continued from Page Eight

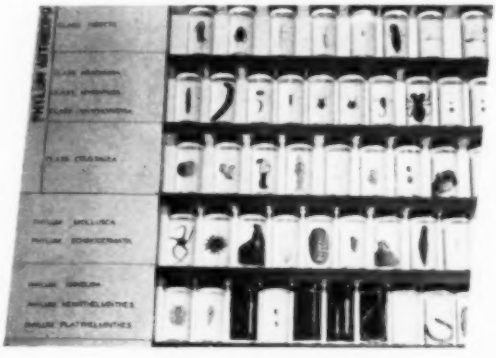
The three books mentioned here describe, illustrate and explain 600 science experiences, 200 in each book, that a child can have with equipment which he either has at home or which he can obtain at moderate cost from the sources mentioned.

Information may be defined as that which a child learns from others by hearing or seeing. Knowledge is that which a child learns from his own experiences. Knowledge is the more important because it becomes a part of his very being. ●

Animal Kingdom

Continued from Page Three

"As for me, an old veteran in the service, I amuse myself with the notion that perhaps some day he and I may find ourselves together collecting Unio and Nereis and Chaetopterus, engaging once more in the lost art of cell-lineage and the more modern one of centrifuging eggs, on some evergreen shore that lies on the other side of Jordan." ●



ILLUSTRATED above is a section of *Ward's Animal Kingdom Survey Collection* consisting of 48 selected types forming the basis for a study of animal characteristics, classification and relationships. A large diagrammatic "tree of animal life" is supplied with each set.

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PROGRAM . . .

Of the eighth annual Duquesne University Conference for Teachers of Science in Catholic High Schools, held in Pittsburgh, February 24, 1940.

PROGRAM

8:30–9:00 **REGISTRATION** Campus Theatre
In charge: W. JOHN DAVIS, A.B., LL.B.
Instructor, Duquesne University
At the Organ: MR. HUGH MACDONALD
Duquesne University, School of Music

9:00–9:40 **GREETING:** Campus Theatre
MOST REVEREND HUGH C. BOYLE, D.D.
Bishop of Pittsburgh
WELCOME
REVEREND THOMAS J. QUIGLEY, M.A.
Superintendent of Catholic Schools, Diocese of Pittsburgh
WELCOME
VERY REV. RAYMOND V. KIRK, C.S.Sp., Ph.D.
President of Duquesne University
ANNOUNCEMENTS
HUGH C. MULDOON, D.Sc.
Director of the Conference

9:45–10:30 **ADDRESS**
Advances Through Scientific Research
EDWARD R. WEIDLEIN, A.M., Sc.D., LL.D.
Director, Mellon Institute, Pittsburgh

10:30–12:00 **PANEL DISCUSSION**
Subject: Making High School Science More Productive
Presiding: VERY REV. RAYMOND V. KIRK, C.S.Sp., Ph.D.
1. **Motivation**
Brother Edward of Mary, F.S.C.
Central Catholic High School, Pittsburgh
2. **Choice of Subject Matter**
Brother Frederick, S.M.
Boys Catholic High School, North Side, Pittsburgh
3. **Classroom Teaching Techniques**
Sister Claretta, O.P.
St. John's Cathedral High School, Milwaukee, Wis.
4. **Laboratory Work**
Sister M. deLourdes, S.S.J. (Baden)
St. Joseph High School, Natrona, Pa.
5. **Better Correlation**
Sister M. Geraldine, R.S.M.
Mt. Aloysius Junior College, Cresson, Pa.
6. **Preparation of the Teacher**
Sister M. Aloysius, O.S.U.
College of New Rochelle, New Rochelle, N. Y.

12:00–1:00 **LUNCHEON** Dining Room, Canevin Hall

1:00–1:40 **DEMONSTRATIONS**
In Chemistry: Room 11
TOBIAS H. DUNKELBERGER, Ph.D.
Graduate Instructor in Chemistry, Duquesne University
In Biology: Room 18
ROBERT T. HANCE, Ph.D.
Graduate Professor of Biology, Duquesne University
In Physics: Room 2
GEORGE E. DAVIS, Ph.D.
Professor of Physics, Duquesne University

1:45–2:30 **ROUND TABLE CONFERENCES**
In Chemistry: Room 11
DR. MULDOON, Presiding
SUGGESTED TOPICS
Preparing and grading examinations.
Readings for chemistry students.
Equipping the laboratory.
Encouraging independent thinking.
Home activities.
In Biology: Room 18
JAMES B. FINN, Jr., M.S., Presiding
Associate Professor of Biology, Mt. Mercy College, Pittsburgh
SUGGESTED TOPICS
Popularizing biology.
Cultivating good health attitudes and practices.
Encroachments on high school biology.
Heredity.
Readings for biology students.
In Physics: Room 2
DR. DAVIS, Presiding
SUGGESTED TOPICS
The indifferent student.
Physics or chemistry first?
Use of formulas in problem solving.
Ultraviolet radiation.
Readings for physics classes.

PROJECT

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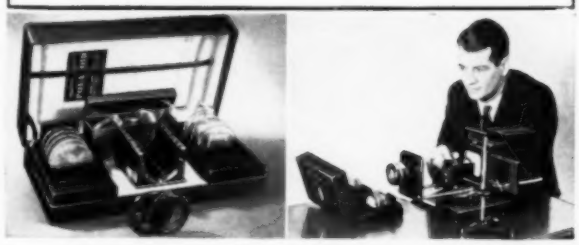

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High School Chemistry

Continued from Page Seven

during the first semester, but certainly the college records and the cooperative test grades indicate that cases 40, 43, 51 and 52 could profitably carry the work.

From the advisor's standpoint, the accumulation of this type of data furnishes further valuable information concerning the student's choice of major study and his likelihood to succeed. The students were cooperative and interested in the results which served as a self-analysis for them. This was particularly true with the national cooperative test which allowed a student to compare his own rating with those in a national group of good size.

One should not pass unnoticed the remaining group of seventy-five students who were grouped together and given a very satisfactory course which was sufficiently challenging to them. Since no chemistry majors remained during the second semester, the subject matter could be chosen with the particular interests and needs of the engineer in mind.

In conclusion, coming back to our original question, it seems evident that the secondary school contribution is extremely important and does function materially in college work. The opportunity for the college lies in recognizing and determining the extent of that background so that the college work in general chemistry may build upon and proceed with the least possible lost motion. ●

WHAT ARE YOU DOING?

- To adjust your subject material to the needs of your class?
- To organize a satisfactory program of health instruction in your school?
- To discover the vocabulary difficulties of the textbook you are using?
- To stimulate your pupils to undertake additional work in science beyond that which is required?
- To improve this year's lesson plans over last year's?
- To correlate your work in science with the non-science subjects of the curriculum?
- To improve your method of testing?
- To direct your pupils in their readings in science?
- To acquire new visual aid materials?
- To make use of the natural advantages of the location of your school?
- To help other teachers of science?

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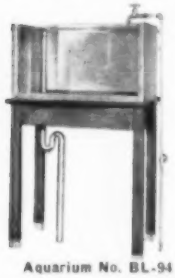

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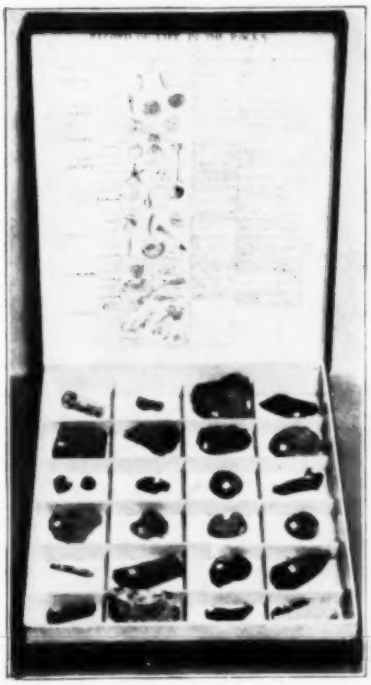

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